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VETERINARY MEDICINE

MARCH

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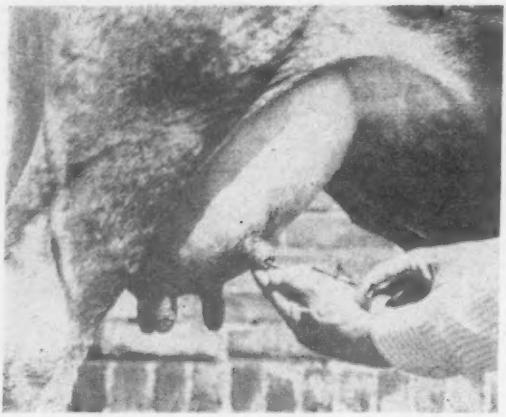
7632 S. Crandon Ave.
Chicago, U.S.A.

Treatment of Streptococcic Mastitis With Ty-Sin*

*(Combination of gramicidin and tyrocidin)

Extensive investigations by Little *et al.* (Rockefeller Foundation for Medical Research), Schalm (University of California), and Greenberg and Bryan (Michigan State College) have shown that the use of gramicidin is an effective, practical means of combating Mastitis due to *Streptococcus agalactiae.* Gramicidin (now designated as tyrothricin, which contains both gramicidin and tyrocidin) is an alcohol-soluble, water-insoluble substance isolated from cultures of an aerobic sporulating soil bacillus. Studies by the Jensen-Salsbery Laboratories have resulted in the development of Ty-Sin, an aqueous alcoholic suspension of tyrothricin (gramicidin and tyrocidin). The active principles are released only from an aqueous medium. Each 20 c.c. of Ty-Sin contains 40 mg. of tyrothricin.



Use of Ty-Sin

Lactating cows — After thorough stripping of the quarter, 40 c.c. of Ty-Sin, which constitutes an average dose, is injected into the milk cistern via the teat canal, under strict aseptic conditions. The quarter is massaged vigorously to disperse the material, and is milked out at the next regular milking. Treatment may be repeated in seven to ten days as indicated.

Dry Cows—One 40-c.c. dose is injected as above, except that the material is left in the quarter. Only one injection is given.

Reactions

In some cases the milk for one to three days may be clabbered, flaky, or stringy. Gross changes in the milk resulting from the treatment usually disappear by the end of the third day. In general, influence on quantity of milk secreted is less than 1 per cent.

Contraindications

Quarters manifesting acute inflammation or marked fibrosis or atrophy should not be treated. It is satisfactory to treat cases showing acute flare-ups after evidence of the inflammation has subsided.

Mastitis Control

In brief, control of Mastitis revolves about the early detection of infected cows, segregation of these animals, precautionary measures to prevent spread of the infection to other susceptible animals in the herd, and the use of Ty-Sin. Physical examination of the udder, use of the thybromol test, direct microscopic examination of stained milk smears, and bacteriological examination of properly collected milk samples are important steps in detecting the infection and appraising the results of treatment with Ty-Sin.

Results

Published data on the use of gramicidin indicate an efficiency of approximately 76 per cent in ridding infected quarters of *S. agalactiae,* which is responsible for over 90 per cent of Mastitis cases today. Controlled studies with Ty-Sin under the same field conditions confronting the practicing veterinarian have demonstrated the like efficiency of this product. On the basis of reactions to the treatments and effectiveness, Ty-Sin is definitely superior to colloidal silver oxide.

Our Laboratories offer Ty-Sin in 250-c.c. vials at $3.25, less discounts of 10 and 2 per cent.

(Write for Literature)

JENSEN - SALSBERY LABORATORIES, INC.

Kansas City, Missouri

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It is reported that vesicular stomatitis has long been enzootic in eastern Texas, but horse owners pay little attention to it because it does not incapacitate the animals and they recover without treatment.

* * * *

The 1942 goal set by the Secretary of the U. S. Department of Agriculture for egg production is four billion dozen eggs. This is a 10% increase over that of 1941.

* * * *

Secretary of Agriculture, Claude R. Wickard, has set the 1942 goal of milk production for the United States at 125 billion pounds—an increase of eight billion pounds over the estimated production during 1941.

* * * *

The 1941 fall pig crop, to be marketed largely in the spring and summer of 1942, is 18% larger than the fall crop of 1940, and 6% above the previous record fall crop of 1939. Indications are that the number of sows to farrow in the spring of 1942 will be about 28% larger than the number farrowing in the spring of 1941, and that the total pig crop for 1942 will be about 97,000,000—about 10,000,000 more than the record pig crop of 1939.

Army parachute troops are now being supplied with small folding stoves for heating emergency rations in the field. These stoves, which can be folded and carried in the pocket, take no more space than an ordinary pocket knife. Heat is furnished by chemical tablets.

* * * *

According to Merle Thorpe, editor of *Nation's Business*, there have been, during the past 40-odd years, 18 great new industries created in the United States, employing some 10,000,000 people; during that same period not one of the other 59 countries on the globe has developed a single great industry.

* * * *

The C. J. Marshall Library of the School of Veterinary Medicine, University of Pennsylvania, includes the memorial libraries of the late Drs. Huidekoper, Pearson, Kimball and McNeil. It also encompasses the Fairman Rogers library and the library of the Philadelphia Society for Promoting Agriculture. Efforts are being made to secure an endowment of $45,000 for this veterinary library; $17,000 has already been donated toward that goal.

Wars to end wars have been waged, and the horseless army has been predicted; but as yet neither end has been attained.—*E. A. Trowbridge.*

One of the first war acts of the Governor of California was to halt the horse races at Santa Anita. These popular races were to have begun December 31st and to have continued until March 14, 1942, running five days each week.

Studies on the breeding and development of medium weight draft horses are being carried out at the Michigan experiment station. It appears possible to select colts at weaning time which will grow true to type in most cases. Grain feeding seems unnecessary for developing work horses when good pasture and roughage are available.

The demand from most average farmers today is for a smaller, more active, good quality horse that will walk faster, trot when drawing a light load, and stand heat well. It is probable that the existing draft breeds will be modified to meet this demand; in fact, a trend in that direction is already noticeable. The smaller animals with the characteristics mentioned sell for as much as, or even more than, work animals weighing 1,800 pounds and upward.—*Wayne Dinsmore.*

Wayne Dinsmore, secretary of the Horse and Mule Association of America, has been selected as the "horseman of the year" (1941) by *Country Life*. The reasons given for the choice of Dinsmore for this honor are: "Because he has battled to keep America aware of the importance of the horse in the economic and military fields . . . he has fought insistently to improve the health of the animals . . . and he has striven, with might and main, to keep the horse in the forefront of public attention."

Mr. Dinsmore is president of the Chicago City Farmers. Many such city farmer groups have been organized in cities in an effort to encourage home production of food products, both animal and vegetable, even on a small plot of land.

Vesicular exanthema of swine is enzootic in California and it cannot be distinguished clinically from foot-and-mouth disease.

The California Department of Public Health inspected 30,000 fleas, collected from all sections of California, during the past year in the course of its plague-control program.

An egg-passage vaccine which has considerable protective value against swine influenza has been developed by Scott of the veterinary faculty of the University of Pennsylvania. It will be remembered that novoxil, as a treatment for mastitis, was first made known by Klein of the same school.

Veterinary College Course Shortened

As a war-emergency measure several of the leading medical and dental schools have gone onto a 12-month basis, doing away with summer vacations and reducing their four-year courses to three years of 12 months each.

Kansas State College and the Texas A. & M. College, including the Veterinary Division in each, have adopted the same plan for the duration of the emergency. In the former school the accelerated curriculum is optional with the student, who may elect to take the regular four-year course in four years of nine months each or in three years of 12 months each. The number of hours required for graduation is the same in both curricula. First, second and third year students may move up the date of their graduation by as much as the amount of summer vacations yet available to them for study.

The Division of Veterinary Medicine of the Colorado State College also has adopted a 12-month, three semester college year and will graduate students from its four-year course in three years. This program is made necessary because the Colorado Selective Service Agency has ruled that military service cannot be deferred for veterinary students during the summer vacation; i.e. they must actually be in school to merit deferment.

MARCH IN IOWA

This is a view on the farm of Dr. John O. F. Price, Algona, Ia. The contented looking sheep are the pride of their owner. Particularly is this true of the head of the flock, a purebred Oxford ram. Doctor Price entered the employ of the Bureau of Animal Industry, U. S. Department of Agriculture, August 1, 1899, and was retired November 30, 1937. He spent 20 years—1917-1937—on hog cholera control in Iowa. The farm to which he retired adjoins the townsite of Algona, his headquarters while in the Bureau

When using phenothiazine in sheep, mention the possibility of wool discoloration to the client. In large bands, losing a pound or so of wool per animal is a serious loss. That is one reason we have not gone crazy about this drug in sheep.—*E. T. B.*

* * * *

For the treatment of infectious keratitis in cattle, M. W. Emmel suggests the use of an ointment of which the chief ingredient is sulfocide (Pratt), a solution which has been used for years as a spray for plants.

In preparing the ointment, 250cc of 5% sulphuric acid in water is added slowly to 250cc of sulfocide, agitating constantly. (Care should be taken not to inhale the hydrogen sulphide which is formed.) The solution is then mixed thoroughly with one pound of anhydrous lanolin and placed in collapsible tubes for dispensing. It is applied daily as required, first warming the tube in hot water.

The ointment has proved highly satisfactory in field trials in Florida, Georgia and Alabama. In most cases one to six applications resulted in complete cure even where total blindness from ulcers of the cornea was present. The ointment was found to be of no value as a preventive, but there was no recurrence of the disease in treated animals.

"Seeing Eye Dogs"

Kennels at Morristown, N. J., are maintained exclusively for the training of "Seeing Eye" dogs. The cost of schooling each individual dog is $1000, which to a large extent is supplied through philanthropy, as the price to the future blind owner is but $150. A case has just become known in which the sight of a man was restored. He had been blind for five years and entirely dependent upon his seeing eye dog. This was the cause of consternation and confusion in the relationship of the two companions, but they are gradually becoming adjusted to the new leadership.

* * * *

More than 100,000 dogs are killed every year on the roads, although to do justice to the vast majority of motorists, who are both careful and considerate, the blame for most of the casualties rests on dog owners. Either they are too lazy to teach their dogs road sense or too careless to keep them under control.—*American Kennel Gazette.*

* * * *

Dogs Susceptible to Tularemia

Heretofore it has been quite generally believed that dogs possess a natural immunity to tularemia. But L. F. Ey and R. E. Daniels, Columbus, Ohio, report cases of the disease in dogs. A hunter and his three dogs went hunting on November 6th. The dogs ran down a rabbit, which they killed, and the master divided it into three pieces, giving one to each dog. The following day the youngest dog became ill and a day or two later the other two dogs were found sick. On November 9th the owner of the dogs had chills and fever, and although he was given antitularense serum he died a week later. Blood specimens from each of the dogs were positive for the tularemia organism, but they recovered.—*Jnl. A. M. A.*

* * * *

Correction

On page 593 of the December, 1941, issue of VETERINARY MEDICINE, it was stated: "A dose of 100gm [of phenothiazine] proved fatal to two horses." It should read "1000gm."

Human poliomyelitis virus has been isolated from naturally-infected flies by independent investigators in Connecticut, Alabama, and Ohio, in both rural and urban areas. Coupled with the seasonal incidence of the disease, this suggests strongly that flies play an important role in transmission of poliomyelitis virus.

* * * *

Robert K. S. Lim, director of the Medical Relief Corps of the Chinese Red Cross, reports that sulfathiazole is being used in treatment of plague among the Chinese. This is practically the first that the drug has been used for plague in man since Karl Meyer proved that it is nearly 98% successful in mice infected with plague. However, plague in mice is a more fatal disease than it is in man.

* * * *

The manner in which leprosy is transmitted from an infected to a susceptible person has long been an unsolved puzzle. Recently Marchoux of the Pasteur Institute (Paris) announced the discovery that the common house fly (*Musca domestica*) and this insect alone may carry the germs of this disease. Insanitary environment, climate, and other factors enter into the picture.

* * * *

In an epidemic of yellow fever which occurred in the Nuba Mountains (Anglo-Egyptian Sudan) in 1940 there were 15,000 cases and more than 1,500 deaths. This is the first epidemic of yellow fever ever recorded in Central or East Africa and the most extensive ever observed on that continent. In addition to the mosquito *Aedes aegypti*, long accepted as the sole vector of yellow fever, there is now evidence that the infection can be transmitted by other mosquitoes, not only in the laboratory but in nature. It is thought that *Aedes vittatus*, an efficient vector of yellow fever in the laboratory, may have played a part in the African epidemic, since the preponderance of cases occurred during the rainy season and *Aedes vittatus* is especially abundant during the rains.—*Annals of Trop. Med. & Parasitology.*

Every veterinarian will agree that it is his duty to preserve animal life at its longest and best. This may be done only by the employment of every agency that gives demonstrable aid, regardless of its origin or authorship. Such agencies are built upon a framework of the veterinarian's student years; of his books and medical journals; and, more important than these, his own clinical experiences and those of his colleagues.

* * * *

"Hang Together or Hang Separately"

Whether or not we like it, our whole social scheme in this country is one of organized minorities in many fundamental respects competing with one another; in other respects, cooperating. One has but to contemplate the labor unions, manufacturers' associations, trade guilds, agricultural federations, professional organizations and religious groups to realize that there is no place for the individual in the determination of even his own destiny.

* * * *

Advances in Veterinary Science

Seven outstanding advances in veterinary science during 1941, which may mean millions of dollars to American livestock producers during the next few years, are listed as follows:

1. The confirmation of calfhood vaccination as a means of controlling bovine brucellosis.

2. The use of the intradermal method of vaccinating against equine encephalomyelitis.

3. Further development of the serum-culture method for the control of swine erysipelas, and the extension of its use by the federal Bureau of Animal Industry.

4. More extensive use of artificial insemination of cattle.

5. Advances in the use of phenothiazine for the treatment of helminths of cattle, sheep, and swine.

6. Advances in the use of sulfonamides in acute infections and wounds.

7. Development of the Habel mouse test to insure the potency and effectiveness of anti-rabies vaccine.

Local Associations Needed

There is a place in this country for national, state and local associations in organized veterinary medicine. The need for local associations is the most urgent because least developed.

* * * *

Birth of State Veterinary Medicine in the U. S.

With the opening for navigation of the Mississippi River at the close of the Civil War, vast herds of cattle from the southwest, that had increased beyond computation during the war, were driven to the north and east as far as Nebraska and Pennsylvania. They carried tick fever with them and communicated it to the native animals. Great excitement prevailed! Contagious pleuropneumonia was extending all the time and in the 70's was destroying ten million dollars' worth of animals annually; worse still, was threatening the extinction of our export trade in cattle. Horses sold by the army at the close of the Civil War carried glanders into every state and county east of the Mississippi River. This disease raged for more than a generation. The loss from it was beyond all computation. Hog cholera was taking a toll estimated at 50 million dollars annually. It was discovered that our hogs were infested with Trichinella, and this threatened our export trade in swine and pork. Perhaps of even more effect on the public than all these combined, was the terrible outbreak of equine influenza in the winter of 1871-72, which put ox teams on Broadway, Broad and State streets and actually threatened parts of our cities with famine because of the inability to transport food.

It was these catastrophes that brought about the establishment of the Bureau of Animal Industry of the U. S. Department of Agriculture and led to limited federal control of epizootics. They also turned the attention of the public to the need for veterinary service and were responsible for the founding and growth of the private veterinary schools, which sprang up in more than a dozen states.

The Federal B. A. I. in 1941

As of June 30, 1941, the Bureau of Animal Industry of the U. S. Department of Agriculture had on its rolls 4,428 regular

John R. Mohler, Chief, Bureau of Animal Industry, U. S. Department of Agriculture

civil-service employees serving in various grades and 1,505 ungraded employees. Veterinarians represented approximately 93% of the 2,081 employees in the professional and scientific service. The following paragraphs are excerpted from the annual report of the Chief of the Bureau for the year ending June 30, 1941.

* * * *

Two of the chief criticisms of calfhood vaccination have been the fear that (1) strain 19, an organism of reduced virulence from which the vaccine is prepared, might regain its virulence in the body of the injected animals, and (2) vaccinated animals might spread the infection if placed in contact with normal susceptible animals. An experiment completed during 1941 showed that the virulence of strain 19 was not increased by repeated animal passage and that vaccinated animals, under the most favorable conditions, did not spread Brucella infection to contact animals.

From July, 1940, to July, 1941, 12,229,499 tuberculin tests were applied to cattle by the combined forces of the state and federal governments. The percentage of reactors was 0.3—the lowest since the project began in 1917.

* * * *

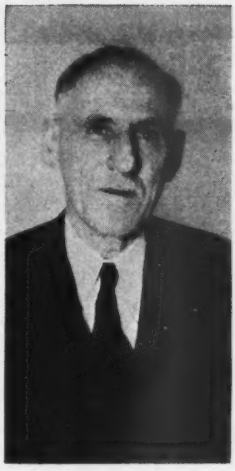
Phenothiazine, in 30gm doses, has been accepted as the standard treatment for the removal of strongyles from horses by the Veterinary Service of the British Army.

* * * *

For a number of years coccidiosis has been an important cause of sickness and death among lambs confined in feedlots. Investigation revealed that corn silage, because of its moisture content, is a favorable medium for the development of coccidial oocysts, and that severe outbreaks occur when corn silage is fed in long, open troughs that are never cleaned. During the feeding season of 1938-39, when silage was fed in this manner, the death losses exceeded 10% of approximately 150,000 lambs. During the 1940-41 period, when lambs were fed exclusively a mixture of alfalfa, molasses, and corn meal, as suggested by Bureau specialists, losses from all causes totaled 2%, those from coccidiosis being practically negligible.

* * * *

Following the favorable action taken by the federal Bureau of Animal Industry in approving calfhood vaccination with strain 19 under proper supervision, a marked increase in the production of this vaccine by commercial laboratories has resulted. During the fiscal year samples from 1,651 batches of commercial vaccine were tested at the Bureau's Animal Disease Station at Beltsville, Md.; of these 1,523 (about 92%) were classed as satisfactory and the remainder condemned. Cultures of strain 19 are furnished periodically to all commercial producers in order that only pure, smooth-type cultures of that strain will be used in preparing this product. These practices have resulted in the continued improvement of the commercial vaccine and the assurance that only a pure, potent product will be distributed by the producers.



Wm. E. Cotton, who developed strain 19 Brucella vaccine. He has retired from the Bureau and is now on the veterinary faculty of the Alabama Polytechnic Institute, Auburn, Ala.

During the same period 302,410cc of strain 19 vaccine were prepared by the Bureau and supplied to federal authorities or cooperators in various states for use in field trials or in "problem herds" in the brucellosis-control program. In addition, 273,900cc of plate antigen and 45,000,000cc of tube antigen were prepared and distributed to state diagnostic laboratories for use in the same program. Uniformity in the interpretation of the test for brucellosis, through the use of this standard antigen, has been shown in repeated check testing.

* * * *

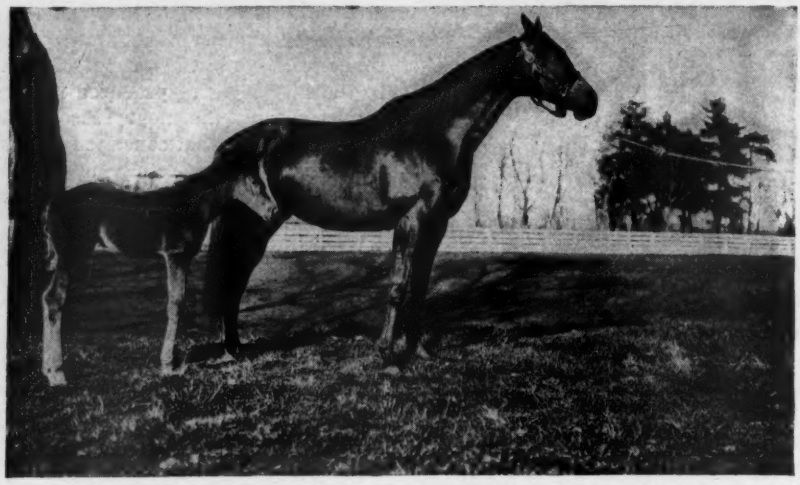
Swine breeding studies carried out by the federal Bureau of Animal Industry show that sows which fail to conceive when first bred as gilts are more likely to fail when rebred for another litter than sows which conceive as gilts. Only about 65% of sows in the first category produced litters when rebred during the next season, whereas 82% of the sows that conceived as gilts produced litters. The results also showed a significant difference in the percentage of conceptions among sows bred for spring and fall litters, respectively; about 89% of the former and 73% of the latter farrowed.

* * * *

The vaccination of young pigs at the Beltsville Research Center with 10cc of anti-swine erysipelas serum at two to four days of age and again at four weeks of age, has practically eliminated the enlarged and swollen joints that were becoming prevalent in increasing numbers of pigs in the herd before this method of treatment was adopted.

The group which assembled in November, 1940, to supervise the culture-serum vaccination of the first herd of pigs in Iowa to receive this prophylaxis against swine erysipelas; a measure which has proved highly successful The men wearing hats are (left to right): Dr. M. E. Pomeroy, Stratford, Ia.; Mr. Veggors, owner of the pigs; Dr. H. A. Seidell, then State Veterinarian, Des Moines, Ia.; Dr. J. A. Barger, Inspector in Charge, Des Moines; Dr. H. J. Shore, Ft. Dodge, Ia.; and Dr. J. S. Koen, B. A. I., Storm Lake, Ia.

Recent data indicate that one of the chief causes of low fertility in mares is irregularity of estrus, accompanied by absence of ovulation or difficulty in determining the time of ovulation. Since successful impregnation is highly dependent on the proper synchronization of mating with ovulation, the federal Bureau of Animal Industry has been conducting studies on shortening the heat period and controlling ovulation. Four commercially available products were used experimentally for this purpose. Product A, of gonadotropic origin, was administered to 12 mares in heat showing follicular development. Only three of these ovulated within 42 hours. Product B, a pregnant-mare-serum preparation, was given to 15 animals, and despite the fact that all showed considerable follicular development at the time of treatment, only three ovulated within 42 hours. Product C, made from beef and sheep pituitaries, did not cause ovulation in any instance, although when injected into six mares not in heat it induced estrus within three days in three instances. Product D, prepared from the urine of pregnant women, was used on 19 mares, 12 of which ovulated in less than 42 hours, and the remainder within four days.



The Bureau's investigations of the causes and remedies of low fertility in mares take on an added importance in the present emergency, when horses are in demand for both military and civilian use

Under the provisions of paragraph 1606 of the Tariff Act of 1930, certificates of pure breeding were issued for 19,104 breeding animals imported during the fiscal year. This is an increase of 4,175 animals, or approximately 27%, as compared with the importations for the previous fiscal year, the principal gains being in the importation of cattle, notably Holstein-Friesian and Ayrshire, and in sheep. Of the breeding animals certified this year, 18,419 came from Canada. Altogether 14,594 cattle, 3,590 sheep, 299 horses, 71 swine, 6 goats, and 544 dogs were imported.

* * * *

The diagnosis of the carrier state of anaplasmosis by direct microscopic examination of blood films has been found to be unsatisfactory. By laking the washed red blood cells of a carrier cow by biological means (anti-ox-hemolysin and complement) and centrifuging at high speed, the resulting sediment was found, on microscopic examination, to contain numerous specimens of spherical bodies resembling *Anaplasma marginale*. This method of diagnosis has been used successfully in both acute cases and carriers of long standing. Preliminary tests indicate that the bodies

demonstrated in the sediment are capable of causing anaplasmosis and are tentatively considered to be the causative agent of the disease.

* * * *

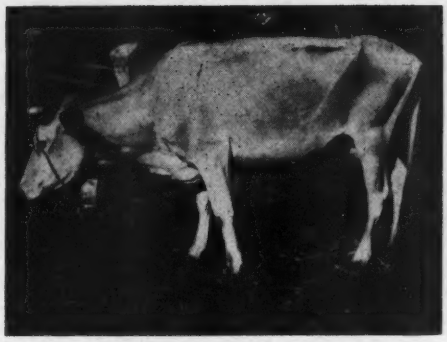
Conium maculatum (poison or spotted hemlock) appears to be spreading in many areas and has become common on some of the higher ranges of the West. The plant is most toxic at the time that the fruits are maturing but are still green, and at this stage of growth it requires approximately one pound of green leaves or one-third pound of green fruits per 100 pounds of body weight to cause death. Early growth of leaves is only about half as toxic as the mature plants, and toxicity is lost rapidly on drying or after maturity.

* * * *

In investigations of stomach worms of cattle (*Haemonchus contortus*) conducted by the federal Bureau of Animal Industry, experiments were made to determine the possibility of host resistance to reinfection. Single or repeated administration of infective larvae to calves resulted first in an accumulation of parasites, then a natural elimination of the worms, after which the hosts resisted the development of stomach worms when infective larvae were fed experimentally or when larvae were ingested under natural conditions on pasture. Previously uninfected calves of the same age were found to be susceptible to similar exposure to infection.

* * * *

Diaphragms from 1,300 farm-raised hogs, reported to have been fed principally grain, were examined for trichinae. Only 13 (1%) were found to be infected with this parasite; the number of larvae in individual diaphragms ranged from 3 to 2,400. Of 294 diaphragms from hogs reported to have been fed wholly or in part garbage as collected, 32 (10.9%) contained trichinae; the number of parasites in individual diaphragms ranged from one to 108,000. These data, as well as those previously reported, show that a relatively small proportion of grain-fed hogs acquire trichinae and that feeding garbage as collected greatly increases the spread of this parasite among these animals.



A typical case of anaplasmosis, showing emaciation and the stance characteristic of the disease. The diagnosis of the carrier state of anaplasmosis has been a difficult problem; the technic developed by the Bureau may prove to be the answer

* * * *

The skin test in its present stage of development cannot be relied on to detect trichina infections in swine. Investigations carried out by the federal Bureau of Animal Industry indicate that the high proportion of nonspecific reactions obtained in skin tests made on a large scale may be associated with garbage feeding.

A fine farm herd of hogs. Data accumulated by the Bureau show that the incidence of trichinosis in such hogs is low when they are fed principally grain; high when they are fed, wholly or in part, uncooked garbage

Beginning last fall, poultry flocks to be classed as U. S. Pullorum-Tested must contain less than 9% of reactors. This percentage is to decrease 1% a year until it is less than 5% by the fall of 1945.

The use of sulphur, in the proportion of 5% of the ration for a week, is recommended by P. P. Levine at the onset of an outbreak among chickens of coccidiosis due to *E. necatrix*. This treatment is advised as a temporary expedient to protect the birds while more permanent measures of sanitation are effected.

Dried yeast reduces perosis in chicks in proportion to the quantity of yeast fed, according to a report in Pennsylvania Agricultural Bulletin 399. A diet containing all known vitamins and minerals required by chicks, including 100 parts per million of manganese, failed to prevent perosis, when yeast was not included.

Chronic diarrhea has been said to cause about 10% of the total number of deficiency diseases observed in clinical practice. Bean and Spies say that chronic diarrhea predisposes to development of deficiency syndromes by causing increased loss and decreased absorption of vitamins.—*Therapeutic Notes.*

W. R. Hinshaw and E. McNeil, of the Division of Veterinary Science of the University of California, make the following suggestions for the eradication of pullorum disease from turkey flocks: (1) make the initial test (standard tube agglutination) at four months of age; (2) divide the flock into small groups on clean ground two weeks before testing; (3) remove the reactors promptly and market them immediately; (4) clean and disinfect all feeding and watering equipment thoroughly; (5) remove all infected pens to clean ground; (6) retest infected pens at monthly intervals; (7) after all groups are free by the pen method of testing, retest the entire flock; (8) use only eggs for poults from free on first test flocks for replacements; and (9) practice a rigid sanitary program.

Chicks with access to sunlight needed but 50 parts per million of manganese in their ration to prevent slipped tendon, but chicks kept in the shade were afflicted even when the feed contained 150 parts per million of manganese, according to the Wisconsin Experiment Station.

Estimates for 1940 show that 18,000,000 baby chicks were sold in Iowa at an average of 10c each, and 2½ million turkey poults at an average of 35c each. The mortality was reckoned at 35%, much of which is chargeable to the doctoring of sick poultry by unauthorized laymen and commercial outfits selling poultry medicines. This mortality entailed the loss of more than $70,000 for the initial cost, to which should be added the cost of feed consumed and of care.—*C. D. Lee.*

In proportion to weight, fowls drink twice as much water as beef cattle, sheep, or swine. One hundred laying hens will drink five gallons of water daily in ordinary weather—much more on hot days. A clean, cool supply of water should be available at all times. There are many different types of watering vessels. A good one should keep the water clean, be easily filled, easily washed, and economical. It should also be constructed so that the water is easily consumed by the chicken.—*Florida Calendar Stock Records.*

In a careful and extensive study of the efficacy of the avian tuberculin test in detecting tuberculosis in poultry, Spears and Dobson conclude that the test is a reliable one on the positive side, the percentage of non-specific reactions being so small as to be negligible. The most undesirable feature of the test, according to their findings, is that in a few instances it does not detect tuberculosis in fowl in which generalized infection is present although the birds are apparently in good condition. Further research into the best methods of producing avian tuberculin and administering the test appears to be desirable, both because of the importance of this disease to the poultry industry, and because of its complicating influence on tuberculosis in cattle and in swine.

A Modified Plan for Swine Sanitation Pays

Fig. 1. FARROWING HOUSE ON THE JOHNSON BROTHERS' FARM

This is a converted farm implement shed. For the spring and fall farrowing seasons it is thoroughly cleaned and disinfected, and divided into 48 pens by movable partitions and gates. It has a concrete floor, making possible a good job of cleaning. The sows, when about due to farrow, are washed thoroughly and put into these pens, where they remain until the pigs are two weeks old. After the farrowing season is over, the gates and movable partitions are stored above the rafters and the building, deeply bedded with straw as shown in the illustration, is used as a shelter for feeder steers and swine

Ten years ago the Johnson Brothers of near Laurens, Iowa, were trying to raise from 300 to 400 pigs annually and were having the usual "bad luck." They were using old lots in which swine had been raised for many years. Parasites and barnyard infections took the usual toll each year. They had the use of their hogs for their pains, but no profit from them because of the toll taken by disease.

They decided to try a sanitation program.

Having no large hog house, they cleared out the machinery and implement shed shown in Fig. 1, constructed movable partitions and gates, and used it as a farrowing house. They cleaned it with hot lye water and gave it a thorough disinfecting. Then they gave the sows that were about ready to farrow a bath and placed them in the clean pens.

When the little pigs were 10 days to two weeks old, the males were castrated. All the pigs were then put in small boxes and the sows in crates and hauled out onto clean pasture. Inexpensive individual houses (Fig. 2) were provided in the pasture for each litter. Temporary sun shelter (Fig. 3) was provided. Water was hauled to the pasture in tanks and kept constantly before the animals in clean troughs (Fig. 4).

The number of sows bred each year was gradually increased until they now raise about 1500 spring pigs and from 500 to 600 fall pigs, or approximately 2000 a year. The hogs are never permitted to come back to the old yards about the barns until they are large enough to put behind the cattle for finishing. Even the anti-hog cholera vaccination is accomplished out in the pasture (Figs. 5 and 6). Temporary restraining pens are arranged for this work.

They use the same pasture for two seasons, then switch to another part of the farm for pasture where hogs have not run for four or more years.

Fig. 2 (above). Types of inexpensive, individual hog houses placed on clean pasture. The sows and pigs are brought to these houses when the latter are about two weeks old and permitted to run on the pasture until they are ready to go into the feed lot

Fig 3 (center). Type of inexpensive shelter house used in clean pasture where the hogs run

Fig. 4 (bottom). Ordinary wood troughs. Note that the surroundings are clean. The troughs are moved from time to time, as may be necessary, to avoid the development of dust or mud wallows

In the spring of 1939 Johnson Bros. had so many sows "coming in" at the same time they could not accommodate them all in the shed, (which contains 48 separate pens) and many farrowed out in the lots. Practically no bathing could be done that spring for all the work "piled up on us all at one time." Thus, for the first time in nine years, the little pigs were farrowed wherever convenient and permitted to run in the old barnyards before being taken to the clean pasture. Since these pigs did not become infested with parasites, it is reasonable to infer that by keeping heavily infested hogs out of the lots for nine years, the parasite eggs originally there had been destroyed and the feeders raised under sanitary conditions had not seriously contaminated them. This constitutes further evidence of the value of keeping hogs out of barnyards.

During ten years of practicing this modified sanitation program there has never been any post-vaccination trouble; never an outbreak of "necro" or enteritis; never any "worming" nor any apparent need for it; and practically no loss from disease of any kind. The inexpensive method of applying this program makes it practicable even on leased farms, where the landlord is unwilling to provide better accommodations.

The Johnson hogs have returned a profit each year since this sanitation program was instituted. So far as an experience with herds ranging up to 2,000 animals over a ten-year period can prove it, the Johnson Brothers' experience proves that *swine sanitation pays good dividends*, provided the method of attaining it is not expensive, nor the labor incurred too onerous.

It might be argued that it is to good fortune rather than to the sanitary program that this farm owes its immunity from swine erysipelas during the past 10 years. But until more is known about how swine erysipelas is spread and what part, if any, post-vaccination breaks and enteritis play in preparing the field for exploitation by Erysipelothrix, no one can be sure that the swine sanitation program has not afforded protection from this disease also. Certain it is that by enabling Johnson Bros. to raise their pigs and thus produce all the feeders required right on the farm, the sanitation program has made it unnecessary to bring onto the premises hogs purchased at community sales, stockyards, or elsewhere, and thus avoided a prolific source for the introduction of all manner of diseases into their herds. Sanitation is responsible for the fact that on this farm swine travel in the right direction—from the farm. It is when the direction is reversed that disease problems multiply. American animal husbandry practices, by moving great numbers of animals of all species between farms and from public stockyards and public sales back to the farm, facilitate tremendously the spread of disease.

Fig. 5 (top). A herd of 1483 healthy swine at pasture on the Johnson Brothers' farm. These hogs were farrowed in the house shown in Fig. 1, and brought to this pasture without ever having had an opportunity to pick up barnyard infection or parasite eggs. They stayed on this pasture from the time they were two weeks of age until they went into the feed lot, to follow feeder cattle

Fig. 6 (bottom). Vaccination of the hogs shown in Fig. 5. Two crews were used and all of the 1483 animals were vaccinated in a single day. The men dressed in white are Dr. A. L. Sundberg, Laurens, and his brother, Dr. C. E. Sundberg of Newell. One helper (kneeling at right) does nothing but refill virus syringes. From his clean clothes and neat appearance one can but conclude he is cleanly, exact and careful in his work.

Approximately 50,000cc of serum was used in vaccinating this herd. No serum shock was encountered and no post-vaccination reaction developed. There are no rings in the noses of these hogs and no rooting was done.

All the pens, chutes, vaccinating troughs and other equipment was taken to the herd for the vaccination, and removed when it was completed.

There has been no loss on this farm from hog cholera, hemorrhagic dysentery, "necro" or other forms of enteritis in ten years; no trouble from parasites, internal or external. Prior to that time and before installing a sanitation program, the annual loss from enteric disease was heavy and post-vaccination troubles were common.

At the present time the supply of riboflavin, in forms suitable for use in enriched flour and like products, is not sufficient. In a canvass it has been found that by the end of the first half of 1942 much more riboflavin will be available, so the mandatory requirements of its use in flours has been postponed until July, 1942, by Federal Security Administrator, Paul V. McNutt.

* * * *

The increasing production of peanut oil meal in recent years has drawn the attention of livestock producers to its use as a feed. It appears to be especially valuable as a high-protein feed in dairy cattle rations; ranking high in palatability and quality of proteins. Tests at the Georgia experiment station indicate that peanut oil meal is somewhat superior to cottonseed oil meal in dairy rations. When the meal comprised 25% of the ration, feed costs for the butterfat production were 21.25 cents per pound, as against 22.27 cents per pound where cottonseed oil meal was fed. No bad effects were observed.

* * * *

New Use for Casein

"Aralac" is the name of the new fluffy, wool-like textile fiber made from casein, a by-product of skimmilk. It is used to blend with wool, cotton, rayon and fur in various proportions according to the particular fabric being made. Aralac is less expensive than wool or fur but costs more than cotton or rayon. Since there are billions of pounds of skimmilk, heretofore of little use, which are left after fat has been extracted for butter and cream, this new product has high potentialities.

About three per cent of cow's milk is casein. When it is separated from skimmilk by rennet it is used for plastics—mostly buttons. But when acid is used the resulting casein is an adhesive. Three-fourths of this type produced is used in paper coating and textile fabrics. It is also of considerable use in the glue industry.

In 1941 there were about 50,000,000 pounds of casein secured through these two methods, in the United States. This is about one-fourth of the world's production —Argentine ranks a close second.

According to the Horticultural field laboratory of the U. S. Department of Agriculture at Orlando, Florida, the mandarin type (satsumas) of oranges and tangerines have nearly three times as high a carotenoid pigment content as ordinary oranges. Other varieties, and grapefruit, provide relatively more ascorbic acid. It is because of such content that rinds of these fruits are being used extensively for stock food in the south.

* * * *

Livestock By-Products Valuable

By-products of livestock have been used to some extent for at least 5,000 years. Hides, skins, and wool are mentioned in the earliest records of mankind. Most of the progress in the development of by-product utilization, however, has come about during the last half-century, paralleling the growth of meat packing as a large-scale industry. The efforts of the meat packers to utilize by-products as a means of eliminating waste have been so successful that in 1939 the wholesale value of livestock by-products in raw material form was $250,000,000—approximately 13% of all meat packing industry products that year.

The utilization of livestock by-products means not only dollars in the packers' pockets, but also the relief of much human suffering from various diseases; e.g. the use of insulin for diabetes, of liver extract for pernicious anemia, and of epinephrine for asthma, hay fever and hives.

Many by-products, important in the aggregate, are found in extremely small amounts in individual animals. Approximately 10,000 cattle, for example, are required to produce one pound of a pituitary gland extract in powdered form .

The meat packer has become increasingly conscious of the economic loss resulting from the substantial percentage of by-products unfit for use. One out of every ten beef livers is condemned as unfit for food. Parasites are responsible for a heavy loss from condemned pork and lamb livers, as well as for lowering the monetary value of sheep, beef and hog casings. Hides damaged by cattle grubs, and sheep and hog lungs by parasites, are other examples of losses which the packer would like to have eliminated.

The Chemo-pathological Aspect of Enteritis

By JOHN A. UTTERBACK, JR.
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COLIC signifies gastric or intestinal pain —enteralgia—and is a symptom rather than a disease. The spasmodic contractions cause pressure upon the sensory nerves in the serous coat of the intestine and mesentery. Under the influence of sympathetic stimulation the intestine becomes relaxed, whereas it becomes tensed when there is parasympathetic stimulation. However, the opposite is true of the splanchnic blood vessels, which contract when the sympathetics are stimulated and dilate when the parasympathetics are excited.

According to Bronk and Larrabee (1939) the hypothalamus plays an important part in the "processes that involve profound changes in visceral activity." The motoneurons are outposts of the nervous system that are extraordinarily sensitive to changes in their surroundings. These sense organs are found throughout the body, in the walls of the viscera, blood vessels, carotid sinus, etc.

To grasp an understanding of the nervous regulation of visceral action requires recognition of the continually shifting influence of the fluids bathing the cells of the nervous system. Bronk (1940).

According to Gasser (1940) a nerve fiber is thought to be a fluid conductor by a "labile surface film," consisting of layers of protein that are separated by "bimolecular layers of lipoid," which is kept in a stable state through the expenditure of energy obtained from oxidation in the fiber. An ionic concentration difference at the borders of the film maintains a potential gradient which falls and allows a current to flow from adjacent segments of the nerve fiber during activity, at which time a molecular change occurs in the surface film. This incites a nerve impulse.

In the state of health the intestinal content is isotonic with blood plasma. The osmotic pressure in the upper portion of the digestive tract is maintained by sodium chloride, going posteriorly the NaCl gives away to $NaHCO_3$. The basic ions of the intracellular fluid (cytoplasm) are potassium and magnesium. The acid ions are proteins and organic phosphates. Bicarbonates, chlorides, and sodium are ingredients of the extracellular body fluids, of which plasma, lymph interstitial fluids and cerebrospinal fluid are the chief examples.

Under the influence of the pathological state known as enteritis, the above normal equilibrium between the cations and anions, as well as the acid-base balance and osmotic pressure between the intracellular and extra cellular fluid systems, are greatly disturbed.

The cases when seen often show inanition, excruciating pain, and evidence of dehydration and diarrhea. This ensemble represents acute water loss accompanied by an increase of erythrocytes and diminution of plasma proteins. The water loss carries out with it the basic ions and chlorides and leaves a preponderance of acid ions remaining in the blood and tissues. Furthermore, there is a marked arteriolar and venular spasm, accompanied by capillary paralysis and dehydration which lowers the blood pressure especially on the venous side due to circulatory stasis. It is said that the venous pressure is the fulcrum of the blood pressure volume. The greatly dilated veins and the immobile plasma colloid within the vascular tree predisposes the patient to secondary shock. Quickly following this there is a sero-hemorrhage infiltration (hemorrhagic infarction) within the muscularis of the intestinal wall, whereas in the mucosae an albuminous fluid exudation occurs along with secretion of mucus, migration of leucocytes. Absorbed bacterial endotoxins and products of protein cleavage give rise to fever in the parenchyma of the organ.

The enormous distention of the intestine, edema and impoverished circulation with the great discoloration seen upon autopsy suggest that tissue death has occurred hours earlier and if so the fine network of nerve plexuses of Auerbach and those of Meissner that envelop the muscularis and mucosae of the organ have suffered to the same end. Thus, the acute pain in the incipient stages of enteritis is often noticed to subside some hours before the patient succumbs.

Studies on Equine Encephalomyelitis

III. Non-Pathogenicity for Chicks of Western Equine Encephalomyelitis Virus

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EQUINE encephalomyelitis virus has been found to be infective for many species of birds. Natural outbreaks of disease caused by the eastern type have been found in the ring-necked pheasant (Tyzzer, Sellards and Bennett,[1] Beaudette,[2] Van Roekel and Clarke,[3] and Beaudette, Black and Hudson[4]), and in the pigeon (Fothergill and Dingle[5]). In addition, Syverton and Berry[6], in a review of the literature on experimental studies, list the chicken, turkey, duck, guinea fowl, bobwhite, quail, valley quail, burrowing owl, English sparrow, Gambel sparrow, cowbird, mourning dove, redwing, grackle, thrasher, junco, and European goose, harrier hawk, blackbird and the tawny vulture as susceptible to infection.

Several investigators have studied the pathogenicity of equine encephalomyelitis virus for chickens. This bird has been found quite susceptible to the eastern type (Giltner and Shahan,[7] Ten Broeck,[8] Tyzzer, Sellards and Bennett,[1] Van Roekel and Clarke,[3] Tyzzer and Sellards;[9] Sellards, Tyzzer and Bennett[10]), but much more resistant to the western type. Giltner and Shahan[11] and Olitsky, Cox and Syverton[12] were unable to produce disease in chicks with the western virus. Tyzzer and Sellards[9] and Sellards, Tyzzer and Bennett[10] reported that two out of three chicks four days of age, inoculated intracerebrally with a 25% suspension of western strain virus from the mouse brain, died, and the third showed symptoms but recovered. Syverton and Berry[6] found that one- to two-day-old chicks were susceptible to intracerebral inoculation with western virus, but that further brain-to-brain passage could not be carried out. They did not indicate the concentration of virus which they used.

In the course of our study of western equine encephalomyelitis virus in the pigeon, we had the opportunity to inoculate chicks with the virus. It is felt worthwhile to record the results which were obtained.

Two strains of western virus, 6289 and 11399, were employed in this study. Some of their characteristics have already been reported (Graham and Levine[13, 14]). These strains had been carried in the pigeon brain for a number of transfers, and pigeon brain tissue suspensions were used to inoculate the chicks.

In December, 1940, 18 chicks, three weeks of age, were injected intracerebrally with strain 6289 virus from the 5th pigeon pass-

*Assigned by the State Department of Agriculture to the Animal Pathology and Hygiene Laboratory to assist in diagnostic work and research.

[1] Tyzzer, E. E., A. W. Sellards and B. L. Bennett, 1938. The occurrence in nature of "equine encephalomyelitis" in the ring-necked pheasant. *Science* 88, pp. 505-506.

[2] Beaudette, F. R., 1939. Neutralization tests with the sera of pheasants surviving an outbreak of equine encephalomyelitis. Third Intern. Congr. Microbiol. Abstr. Commun., p. 93.

[3] Van Roekel, H. and M. K. Clarke, 1939. Equine encephalomyelitis virus (eastern type) isolated from ring-necked pheasant. *J. A. V. M. A.* 94, p. 466.

[4] Beaudette, F. R., J. J. Black and C. B. Hudson, 1941. Another case of equine encephalomyelitis in New Jersey pheasants. *J. A. V. M. A.* 98, pp. 449-450.

[5] Fothergill, L. D. and J. H. Dingle, 1938. A fatal disease of pigeons caused by the virus of the eastern variety of equine encephalomyelitis. *Science* 88, pp. 549-550.

[6] Syverton, J. T. and G. P. Berry, 1941. The transmission of equine encephalomyelitis to the western burrowing owl, *Speotyto cunicularia hypugaea* (Bonaparte). *Am. Jnl. Hyg.* 33:B, pp. 37-41.

[7] Giltner, L. T. and M. S. Shahan, 1936. The present status of infectious equine encephalomyelitis in the United States. *J. A. V. M. A.* 88, pp. 363-374.

[8] Ten Broeck, C., 1938. Birds as possible carriers of the virus of equine encephalomyelitis. *Arch. Path.* 25, p. 759.

[9] Tyzzer, E. E. and A. W. Sellards, 1941. The pathology of equine encephalomyelitis in young chickens. *Am. Jnl. Hyg.* 33:B, pp. 69-81.

[10] Sellards, A. W., E. E. Tyzzer and B. L. Bennett, 1941. The infection of birds with the virus of equine encephalomyelitis. *Am. Jnl. Hyg.* 33:B, pp. 63-68.

[11] Giltner, L. T. and M. S. Shahan, 1933. Transmission of infectious equine encephalomyelitis in mammals and birds. *Science* 78, pp. 63-64.

[12] Olitsky, P. K., H. R. Cox and J. T. Syverton, 1934. Comparative studies on the viruses of vesicular stomatitis and equine encephalomyelitis. *Jnl. Exp. Med.* 59, pp. 159-171.

[13] Graham, R. and N. D. Levine, 1941. Studies on equine encephalomyelitis. I. Antigenic properties of pigeon brain tissue vaccine. *Am. Jnl. Vet. Res.* 2:5, pp. 430-435.

[14] Graham, R. and N. D. Levine, 1942. Studies on equine encephalomyelitis. II. A non-antigenic strain of pigeon brain virus. *Am. Jnl. Vet. Res.* (in press).

age. Two chicks each were inoculated with 0.1cc of 1-10, 1-20, 1-40, 1-80, 1-160, 1-320, 1-640, 1-1,280, and 1-2,560 suspensions. No titrations of the inoculum were carried out in other animals, but 0.1cc of a dilution of 1-1,000,000 killed pigeons when inoculated intracerebrally. All the chicks, however, remained healthy.

At the same time, 18 chicks three weeks old were inoculated intracerebrally with strain 11399 virus from the 12th pigeon passage in the same dilutions as above. One-tenth cubic centimeter of this in a dilution of 1-1,000,000 killed pigeons when inoculated intracerebrally. All the chicks remained healthy.

In May, 1941, a further series of 15-day-old chicks was inoculated with strain 6289 virus. At this time the virus had passed through 29 transfers in the pigeon brain. No titrations of the inoculum were made, but pigeons inoculated at the same time with 0.1cc of a 1-100,000 suspension died with typical symptoms of the disease.

Three chicks each were inoculated intracerebrally with 0.1cc of dilutions ranging from 1-100 to 1-10,000,000; and three chicks were inoculated subcutaneously and three intraperitoneally with 0.1cc of dilutions ranging from 1-10 to 1-1,000,000. With the exception of birds which died from trauma or intercurrent disease, all the chicks were released healthy a month after exposure.

So many avian species are susceptible to the virus of equine encephalomyelitis that it has been suggested that birds may be the natural hosts, horses (and man) being infected only adventitiously. Strangely, it has been found that although the chorioallantoic membrane of the chick embryo is an excellent medium for the propagation of both the eastern and western strains of the virus, and although chickens are quite susceptible to the eastern type, they are remarkably resistant to intracerebral inoculation with the western type

These results indicate that the chick is refractory to infection with two strains of western equine encephalomyelitis virus in the dosage and by the inoculation methods employed. This is an interesting contrast to the well-known extreme susceptibility of the chick embryo (Higbie and Howitt[15]), and also to the susceptibility of chicks to the eastern type of the virus. It should be pointed out, however, that if younger chicks or heavier doses had been used (as by Tyzzer and Sellards[9] and Syverton and Berry[6]), the chicks might have succumbed.

Summary

Two- to three-week-old chicks were found refractory to infection with two strains of western equine encephalomyelitis virus under the experimental conditions employed.

[15] Higbie, E. and B. Howitt, 1935. The behavior of the virus of equine encephalomyelitis on the chorioallantoic membrane of the developing chick. *Jnl. Bact.* 39, pp. 399-406.

Malignant Lymphocytoma in a Young Calf

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RECENT observations with regard to tumors of cattle indicate that those of the lymphoid group are probably the most common of the malignant neoplasms, particularly in adult cattle. This type of neoplasm, however, is seen far less frequently in young cattle, or in animals under one year of age. Feldman[1] found the average age in cases of lymphatic tumors in cattle examined by him to be six years. Recorded cases indicate that such lymphoid neoplasms in young calves are extremely rare. Udall and Olafson[2] reported a case, which they designated pseudoleucemia, in a six-weeks-old Guernsey calf, in which there was involvement of the various body and visceral lymph glands, liver, kidneys, and spleen.

The case of malignant lymphocytoma reported here was in a male Jersey calf, the exact age of which was not available. It was judged, however, that the calf was under two months, and possibly not over six weeks, of age. The case was first called to our attention by Dr. R. H. Brooks, a member of the meat inspection force of Cleveland, Ohio, at which station the animal was first observed on ante-mortem inspection. The

Fig. 1. The calf described in the report. Note the greatly enlarged parotid, prescapular, and precrural lymph glands

calf attracted particular attention because of the marked bilateral enlargement of the parotid, prescapular, and precrural lymph glands (Fig. 1). Otherwise it appeared to be in good physical condition.

On autopsy all the body lymph glands, and also the visceral lymph glands, were found to be enormously enlarged (Fig. 2-A). They were softer than normal, and several were hemorrhagic. Numbers of grayish nodular growths, varying in size, were seen distributed through the liver (Fig. 2-B), and similar growths were observed in both kidneys (Fig. 2-C). The heart, lungs, and spleen apparently were not involved. Specimens of lymph glands and the different organs were submitted to the laboratory of the Pathological Division for histological examination, and a diagnosis of malignant lymphocytoma was made.

In sections from the different tissues involved the neoplastic cellular elements were found to consist of compact masses of immature lymphocytes, with very limited connective tissue stroma. There were indications of rapid growth and destruction of the invaded tissues. This was particularly in

Fig. 2. (A) A cross section of the enlarged popliteal lymph gland. (B) A small portion of the liver, and (C) of the kidney of the calf, in which the grayish nodular growths may be seen

[1] Feldman, William H., 1932. *Neoplasms of Domesticated Animals* (W. B. Saunders Company, Philadelphia), p. 215.

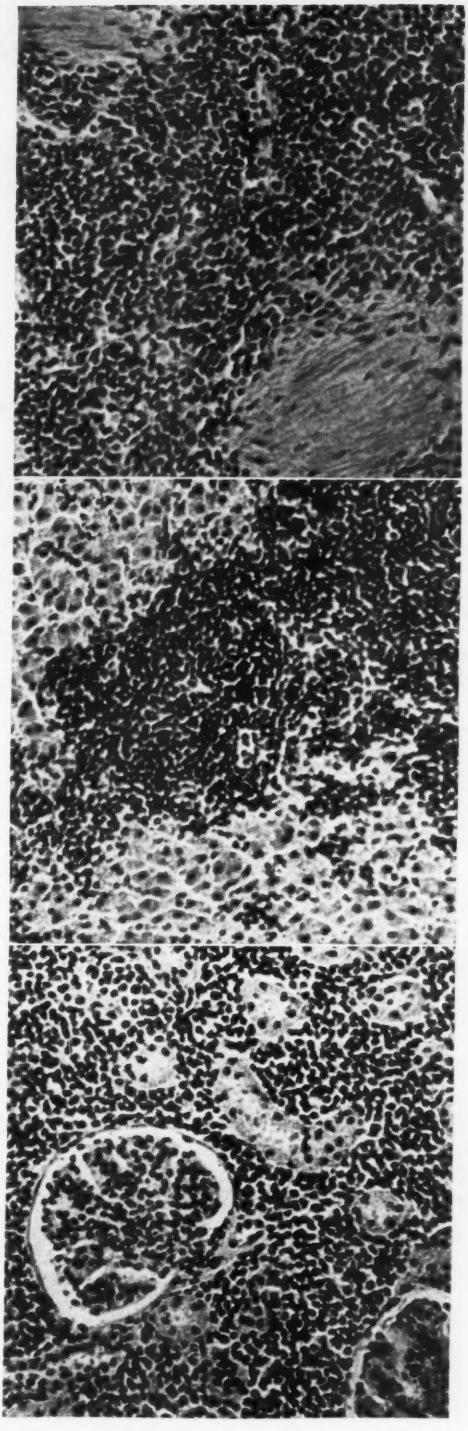

Fig. 3 (Top). Photomicrograph of section of enlarged popliteal lymph gland of calf in which the tumor cells have largely replaced the normal gland structure. Remnants of a few of the trabeculae can be seen. X200

Fig. 4 (Center). Photomicrograph of section of calf liver showing masses of infiltrating lymphocytes replacing large areas of liver cells. X 200

Fig. 5 (Bottom). Photomicrograph of section of calf kidney in which masses of lymphocytes can be seen infiltrating between and replacing many of the tubules. X200

evidence in the lymph glands, in which the normal gland structure had been largely replaced by the infiltrating tumor cells (Fig. 3). In the liver there was very little infiltration of the sinusoids, the invading cells being observed chiefly as large foci, or nodular masses, replacing the liver substance (Fig. 4). In the kidneys the tumor cells were infiltrating between, and destroying, the kidney tubules, and in some portions consisted of large cellular areas in which the tubules had completely disappeared (Fig. 5). No evidence of metastasis was found in sections from the heart, lungs, or spleen.

The chief point of interest in this case is that of the age of the affected calf. The occurrence of extensive lymphoid neoplastic disease at such an early age tends to revive the ever-interesting question of etiology in such cases. Udall and Olafson[2] obtained cultures of organisms from the lymph glands in the case previously referred to and were inclined to the opinion that infection in this particular calf may have been a factor in initiating the lymphatic disturbance.

No bacterjological studies were made of the case reported here, and no tissue changes indicative of possible infection were seen in any of the tissue sections examined. In this connection it is of interest to note that in a recent article on lymphocytoma in dairy cattle Starr and Young[3] make the interesting observation that this type of neoplasm is more common in dairy breeds, and that the frequency of occurrence in certain families of cattle indicates a possible genetic factor. While conjecture regarding the etiology of these neoplastic conditions is of interest there is still complete absence of any definite knowledge concerning the specific causative factor or factors involved in such cases.

[2] Udall, D. H., and Olafson, P., 1930. Pseudoleucemia in a calf. *Cor. Vet.* 20:1, pp. 81-84.

[3] Starr, L. E., and Young, T., 1941. Lymphoblastoma in dairy cattle, *Vet. Med.* 36:8, pp. 406-408.

Phenothiazine Poisoning in Pigs

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PHENOTHIAZINE has recently been widely utilized as an anthelmintic in the treatment of various species of farm animals. At first this drug was believed to possess low toxicity with slight danger from over-dosing. However, it is now known that while in some species of animals the toxic dose of phenothiazine is much greater than the therapeutic dose, in others the difference between the two amounts may be quite small. The anemia which phenothiazine may cause in horses was first pointed out by Errington and Westerfield,[1] and since that time many reports have appeared in literature on anemia, kidney damage, and death due to administration of phenothiazine to horses. Boley, Morrill and Levine[2] have reviewed the literature on the effect of this drug on horses.

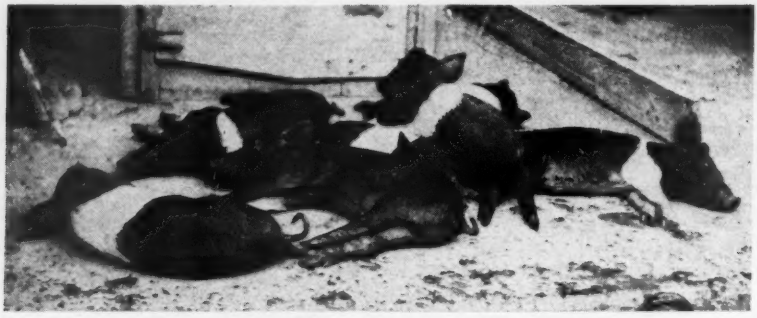

Fig. 1. A group of pigs 48 hours after treatment with phenothiazine

Phenothiazine was introduced as an anthelmintic for swine by Harwood, Jerstad and Swanson[3] and their observations were confirmed by Swanson, Harwood and Connelly[4]; Boley, Levine, Wright, and Graham;[5] and Roberts.[6] However, Lapage[7] reported failure of the drug to remove ascarids from swine. Briefly, phenothiazine appears to remove a high percentage of nodular worms (Oesophagostomum), but its action against Ascaris appears to be variable and less effective.

Lapage[7] first noted symptoms of incoordination in some of the young pigs which he treated with phenothiazine, and Lekwa[8] has reported nervous symptoms and also paralysis in pigs treated with the drug.

Observations

The present report describes a case of phenothiazine poisoning in which the owner either failed to correctly estimate the weights of the pigs or did not follow the prescribed dose on the package. Shortly after weaning the pigs were subjected to a 30-

* Assigned by the State Department of Agriculture to the Animal Pathology and Hygiene Laboratory to assist in diagnosis and research.

[1] Errington, B. J. and C. Westerfield, 1940. Phenothiazine as an anthelmintic for horses and mules. *Vet. Med.* 35, pp. 688-693.

[2] Boley, L. E., C. C. Morrill and N. D. Levine, 1941. A note on the effect of large doses of phenothiazine on draft horses. *Vet. Med.* 37, pp. 26-29.

[3] Harwood, P. D., A. C. Jerstad and L. E. Swanson, 1938. The efficacy of phenothiazine for the removal of ascarids and nodular worms from swine. *Jnl. Parasit.* 24, pp. 16-17.

[4] Swanson, L. E., P. D. Harwood and J. W. Connelly, 1940. Phenothiazine as an anthelmintic for the removal of intestinal worms from swine. *J.A.V.M.A.* 96, pp. 333-338.

[5] Boley, L. E., N. D. Levine, W. L. Wright and R. Graham, 1941. Phenothiazine in the treatment of gastrointestinal parasites of animals. *Ann. Rep. Ohio State Vet. Med. Assoc.* 1941, pp. 25ff.

[6] Roberts, F. H. S., 1941. Phenothiazine as an anthelmintic for horses, cattle and pigs. *Austral. Vet. Jnl.* 17, pp. 130-137.

[7] Lapage, G., 1940. Experiments on the anthelmintic action of phenothiazine. *Vet. Rec.* 52, pp. 648-657.

[8] Lekwa, C. L., 1941. Phenothiazine poisoning in swine. *Vet. Med.* 36, p. 448.

hour fast and then fed a corn and oats slop to which had been added 909gm of phenothiazine. The pigs ranged in weight from

Fig. 2. Corneal opacity following treatment with phenothiazine

10 to 30 pounds, their average weight being approximately 20 pounds. There were 112 animals, so that the theoretical dose received by each was 8.11gm, or almost twice the prescribed dosage of 0.5gm per kilogram body weight (4.6gm for a 20-pound pig).

Five hours after feeding, the owner first noticed signs of poisoning. Approximately 10 hours after treatment, only 12 pigs were able to stand. Twelve hours later there was some improvement, and in another eight hours half of the animals were able to walk. Two days after treatment, 22 more pigs were on their feet, but 26 were still unable to rise, and two runts had succumbed.

The symptoms manifested were those of a central nervous system derangement. The pigs able to stand showed incoordination with marked weaving of the hind quarters when they walked. A few tilted their heads to the side and were unable to progress in a straight line. A number of the animals which were down showed complete posterior paralysis, while others made repeated attempts to rise or made running motions as they lay on their sides. Still others were semi-comatose (Fig. 1). The appetite was not greatly impaired, for when supported at the feed or watering trough the pigs ate and drank eagerly. Some, even though they suffered from posterior paralysis, were able to drag themselves to the feed and water troughs.

Extensive corneal opacity appeared in many animals 48 hours after treatment (Fig. 2). The majority of these pigs suffered only a temporary blindness, recovering before the sixteenth day, but six were affected for a longer period of time. Both unilateral and bilateral keratitis were seen.

That the drug was being eliminated was indicated by the red color which the urine assumed after exposure to the air for a few minutes.

The temperatures of five affected pigs ranged from 98.4°F. to 100.8°F.

Blood samples were obtained by tail or ear bleeding from three pigs the day after they received phenothiazine, and from four more on the eleventh day. Leucocyte counts, erythrocyte counts, and hemoglobin levels were all within the normal range.

Fig. 3. A group of pigs convalescent from phenothiazine poisoning

Autopsy of one pig 11 days after administration of the drug revealed a diffuse yellowish discoloration of the liver, especially prominent toward the centers of the lobules, but the organ did not show any appreciable alteration in size or consistency. Omphalitis and unilateral corneal opacity were present. All other tissues were apparently normal on gross examination.

In a second specimen which died at 21 days no significant gross lesions were observed on post-mortem examination, and the cornea appeared normal.

Discussion

This experience and others reported in the literature indicate the advisability of care in the use of phenothiazine in swine. The weights of the animals should not be estimated but representative individuals should be weighed, and the dosage accurately determined. Individual treatment by capsule or with a suspension of the drug should provide a higher degree of safety. If it is desired to mix the drug in the feed, it would be well to separate the pigs into groups on the basis of size before feeding.

While phenothiazine is the only known drug which will expel Oesophagostomum, its action against Ascaris is not so certain. Further research is indicated to determine whether this drug should be recommended for swine ascarids.

Summary

A case of poisoning in swine due to treatment for worms with an overdose of phenothiazine is described. Symptoms included incoordination, posterior paralysis, and corneal opacity. Two of the 112 affected animals succumbed.

The preceding report adds to the growing list of records of untoward results following the injudicious administration of phenothiazine by laymen. It underlines the truism that no drug, whatever its margin of safety, is foolproof in inexperienced hands. Phenothiazine is a valuable anthelmintic, for swine as well as for other animals, but like other drugs it should be prescribed by a veterinarian and administered according to his directions

Chronic Swine Erysipelas*

By G. C. HOLM, R. L. GRIFFITH, JR. and W. M. BEESON†

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CHRONIC swine erysipelas is usually considered a sequel to the acute or urticarial form of the disease. During recent years, however, many cases of the chronic form have been observed in herds with no history of previous erysipelas infection. The condition is usually manifested as an acute, transient or chronic lameness.

For the past several years there has been considerable lameness among the young stock of the University of Idaho Agricultural Experiment Station swine herd, appearing in approximately 40% of the pigs before they reached four months of age. The manifestations were a slight continuous lameness, a transient lameness of one or two days, or a severe attack, with the development of a pronounced swelling of the joints. Usually in the more severe cases a rise in temperature and inanition were observed. The involved joints remained swollen for a long period, and a proliferative periostitis developed which seriously handicapped the animal in its growth. The effects of the first two types of the disease were not of long duration. In the third type additional time was required to fit the animal for market because of loss in condition.

Through clinical observations, pathological findings, serological tests, and bacteriological examinations, this disease was diagnosed as chronic swine erysipelas. This form of the disease, as well as the acute and occasionally the urticarial types, has been encountered throughout Idaho; the majority of the cases, however, have shown a clinical manifestation only of an arthritis affecting the tarsal, carpal and digital joints.

The investigation was carried on under two sets of conditions. Observations and experiments were made on the experiment station herd, while an epizootiological study was carried on throughout the state to determine the prevalence of the malady.

Observations and Experiments on University Herd

A study was made of the control possibilities through the use of a strictly enforced McLean system of sanitation. It was necessary to have a knowledge of the blood titres of individual pigs. The technic employed in blood testing was that of Schoening and Creech.[1] The antigen used was supplied by the Bureau of Animal Industry of the U. S. Department of Agriculture.[2]

Observations on Reactions in Young Spring Pigs on Infected Ground.—June 9, 1939, 48 spring pigs of the Poland China and Duroc breeds of weaning age (eight weeks) were tested. One animal reacted in a dilution of 1:100. Eleven days later 33 of these pigs were retested, 17 reacting in dilutions of 1:100, 11 giving suspicious reactions in that dilution, and five remaining negative. Most of these pigs continued to have, or developed, a positive reaction to the test, and in two cases the titre was increased to 1:400, with a weak reaction at a dilution of 1:800. At no time was sickness observed in these animals as a group. No deaths occurred, and only one Duroc pig developed a chronic arthritis with enlargement of the joints. Numerous animals showed a mild, transient lameness. With the present knowledge of immunology and serology it must be accepted that the positive reaction of blood serum in higher dilutions to a specific antigen indicates that the animal has been or is infected, or that the organism is present without producing the disease.

These animals were maintained in a lot that had been used in swine production for

* Published with the approval of the Director of the Idaho Agricultural Experiment Station as Research Paper Number 197.

† Station Veterinarian, formerly Graduate Assistant, and Associate Animal Husbandman, respectively.

[1] Schoening, H. W., and G. T. Creech, 1936. Swine erysipelas—with particular reference to serological diagnosis. *J.A.V.M.A.* 41:3, pp. 310-316.

[2] Grey, C. G., O. L. Osteen, and H. W. Schoening, 1941. Swine erysipelas, the agglutination test for its diagnosis, and a report or a study of arthritis in swine. *Am. Jnl. Vet. Res.* 2:2, pp. 74-76.

many years. Therefore, they had ample opportunity to become infected by the disease organisms present in the soil.

Observations on Reactions in Young Fall Pigs on Infected Ground.—It is interesting to observe that an apparent seasonal variation in the incidence of joint lesions closely followed the seasonal incidence of swine erysipelas as noted by Van Es and McGrath.[3] During the first quarter of the year the occurrence of joint lesions was rare, while during the third quarter the incidence was highest. The fact that a majority of pigs reached three to four months of age during the third quarter, makes this seasonal incidence seem more pronounced. It was observed that arthritis did not develop in animals more than eight months of age, although certain animals of greater age did show joint lesions which had developed in early life.

Twenty 1939, fall pigs were tested during the winter and spring. Eleven of these remained negative in a dilution of 1:50, and two were still negative when retested in July. The strongest agglutination titre developed by any of these pigs was a reaction weakly indicative of a positive reaction in a dilution of 1:100.

Observations on Pigs from Reactor Sows on Clean Ground.—A series of pregnant sows were transferred to ground some distance from the University farm, which had never been used for swine production. These sows were thoroughly washed with soap and water, and scrubbed with a mild disinfectant before being hauled to the new location.

One Poland China sow gave a positive reaction in a dilution of 1:100, but was negative at 1:200 at the time of transfer. A Duroc sow had a positive reaction at 1:200, but was negative at 1:400 on the same day. When tested three months later the former animal reacted in a dilution of 1:500, and the latter in a dilution of 1:1000. This gradual increase of agglutination titre would indicate that both animals were in contact with the causative organism of swine erysipelas.

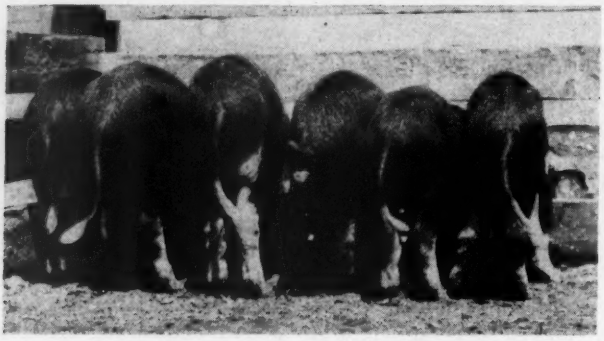

Fig. 1. A litter of Poland China pigs 3½ months of age, showing varying degrees of coarseness of the hock resulting from arthritis. Note the extreme enlargement of the hocks of the animal on the right, and the thickening in the proximal metatarsal region. The "cow-hocked" stance is common among affected pigs

In the Poland China litter five pigs were negative with one exception, which had a weakly suspicious reaction at 1:100. In subsequent tests up to the age of four months all pigs developed a titre of 1:100, with the exception of the pig with the weakly suspicious reaction on the first test, which showed no change.

In the Duroc litter of eight pigs there were three negative and four suspicious reactions at 1:100, and one reaction of 1:100. When three of the animals were tested at six months of age, two had a strongly suspicious reaction at 1:400, and the other was positive at 1:100 with a suspicious reaction at 1:200. No lameness or arthritis was noticed in any of these pigs at any time.

In March, 1940, four sows (Poland China sows Nos. 2 and 6 and Duroc sows Nos. 1 and 19) were placed on the ground which had

[3] Van Es, L., and C. B. McGrath, 1936. Swine erysipelas. *Neb. Agr. Exp. Sta. Res. Bull. No.* 84.

been used by the two fall litters. These four animals had shown a positive reaction of 1:100 in 1939. In a complete test of all sows and pigs, made when the pigs were one month of age, sows Nos. 2, 6, and 1 showed reactions at 1:200, while No. 19 remained the same as in the previous test. All pigs were negative at 1:100 except those of Poland China sow No. 26. Two of the eight pigs of this litter were negative at 1:100, four were weakly suspicious, and two were positive. When tested one month later the reactions of the sows were slightly weaker, but all the pigs were negative at 1:100 dilution.

At no time during this experiment were these pigs lame. Since none of the pigs on this lot maintained a reaction, it would be safe to assume that it was not a soil- or water-borne infection which caused the fall pigs to react. The infection in the fall pigs was probably brought about through contact with the sows, either of which might have been active reactors.

A similar experiment was carried out on another plot of ground. Four pregnant Poland China sows were introduced, using the same procedure as in the previous experiment. When the young pigs were tested at weaning age all were negative except four in one litter, three of which showed a strong reaction at 1:100, and the other a positive titre at 1:200. When tested at four months of age, the blood titre had increased to positive at 1:400 for two pigs, and at 1:800 for the other two. The other pigs were negative. Those with the positive blood titre showed severe lameness with enlargement of the tarsal and carpal joints about 30 days after the first positive test. The manner in which the arthritis followed the blood titres was characteristic of chronic swine erysipelas.

Transient lamenesses have been noted in suckling pigs. In all instances the titre of the sow was above 1:800. The suckling pigs usually carried titres of 1:400 or above. The milk from some of these sows was injected subcutaneously into pigeons with no fatalities. Other suckling pigs have shown lameness which could definitely be traced to an omphalitis; in these cases staphylococci usually could be isolated and no reaction to swine erysipelas antigen was noted.

Serum Treatment of Lame Pigs.—Swine erysipelas immune serum was used as a treatment in a small number of arthritic pigs. Two Duroc pigs from the same litter

Fig. 2. Barrow showing pronounced enlargement of the right carpus as compared to the normal left joint. The lack of condition shown here is characteristic of severely affected animals. Involvement of the hocks is also apparent

showing enlarged, tender joints were given 10cc of swine erysipelas immune serum. One pig appeared to improve, and a second injection was given at the time. This pig soon recovered and showed no further signs of arthritis. The second pig, after a two-day period was apparently getting worse. The second injection did not improve the condition. A third pig injected with 10cc of swine erysipelas immune serum appeared to improve for several days, then returned to its former condition. It is felt that in the two latter cases early administration of immune serum might have led to recovery. As it was, the pathological processes had developed to the point where mechanical injury was irreparable.

Etiological Observation

In the course of necropsies on animals having enlarged joints, cultures have been made and the organism of swine erysipelas, *Erysipelothrix rhusiopathiae*, isolated. The number of satisfactory isolations was relatively small, however. Only two cases were observed in which vegetative endocarditis was present. Occasionally, staphylococci

were found. Some of the cases were traceable to an omphalitis.

also slaughtered. The incidence of lameness gradually decreased until at the present

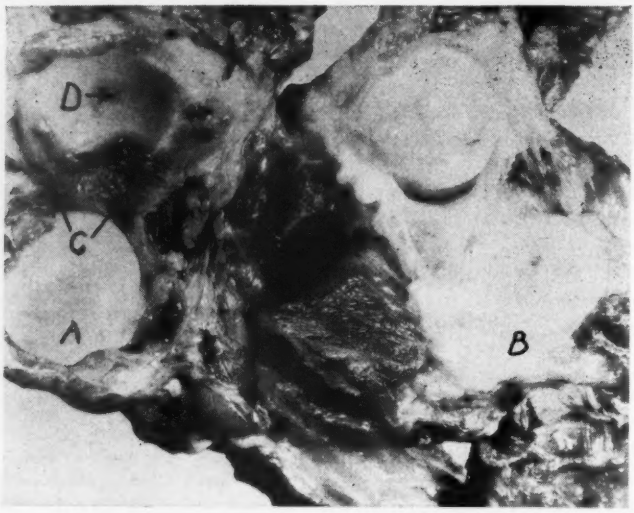

Fig. 3. A photograph giving a comparison of the appearance of the arthritic right scapulo-humeral joint, A, of a Duroc Jersey pig with the normal left joint, B. The inflamed condition of the joint capsule can be seen readily on the left, designated by the letter C. The dark-colored area in the glenoid cavity of the scapula, D, is an erosion one-eighth inch deep

Since Erysipelothrix[4] is a genus of the Actinomycetaceae family, it was thought that the common Actinomyces organism might induce an agglutination response similar to that of the swine erysipelas organism. A mixed culture of Actinomyces organisms isolated from soil in the swine yards was used as an inoculum. Three rabbits, negative to the agglutination test for swine erysipelas, were used in the experiment. One received 2cc of the mixed culture subcutaneously, one was fed a portion of the culture in water, and the third animal was maintained as a control. At nine days all the animals were negative to the swine erysipelas agglutination test in dilutions of 1:25. These animals continued to be negative to this test.

Eradication of Carrier Pigs

Breeding animals which showed clinical symptoms and a positive titre were disposed of through government inspected slaughter houses. Some individuals showing no manifestations of chronic swine erysipelas, but having titres of 1:400 or more, were

Fig. 4. Extensive exostosis of central and third tarsal bones, A, with a slight proliferation on the head of the third metatarsal and central tarsal bones, B, can be seen in this photograph. The growth designated C, is a bony mass attached to the third tarsal bone. The central, third and fourth tarsal bones are fused

[4] Bergey, D. H., 1939. *Manual of Determinative Bacteriology.* 5th Edition, Williams and Wilkins, Baltimore, Md.

time no cases of chronic swine erysipelas or arthritis have been observed. Enlargement of joints due to omphalitis has been noted, but in these instances the individual has been negative to the agglutination test. Two young litters developed a severe lameness during the dark, cloudy, spring period, but responded immediately to vitamin D therapy. These individuals did not react to the agglutination test.

Hog Pool Survey

Of 1,300 representative pigs observed at hog pools in the northern part of Idaho, only two were affected with typical arthritis. One hundred ninety-nine blood samples were collected at random from 107 lots of pigs, and 141, or 70%, showed agglutination in the dilution of 1:50. Many ranches which were the sources of reacting pigs were visited. All pigs appeared healthy and normal. From this evidence collected from representative groups of hogs it is apparent that the clinical symptoms do not agree with the results of the agglutination test for swine erysipelas when conducted at 1:50 dilution. It is interesting to note that the majority of pigs showing clinical manifestations of either the urticarial or arthritic forms of the disease, carry titres of 1:400 or over.

Recommendations for Control

1. A strict system of sanitation should be followed.

2. Swine having titres of 1:400 and clinical manifestations of arthritis should be eradicated. It may be advisable also to eradicate animals with titres of 1:400 even though clinical manifestations are absent.

3. All pigs farrowed should have their navels painted with iodine or iodine glycerine at birth. Weaned pigs should be placed on ground that has not been used for swine production the previous year.

Summary

It has been shown that through strict sanitation together with a program of eradication the chronic form of swine erysipelas can be controlled. Not all cases of arthritis are due to swine erysipelas, but may result from injury, omphalitis, rickets, or swine brucellosis.

Swine erysipelas has been receiving a good deal of attention during the last few years. As Frank Breed pointed out in the February issue of VETERINARY MEDICINE, the recognition and control of this insidious disease is one of the most difficult problems that ever confronted our profession. At veterinary meetings and conferences, practitioners show a lively interest in the subject. Here H. R. Hester, of the University of Illinois, is shown demonstrating the lesions of swine erysipelas to an interested group

The Dog Strongyloides

With Special Reference to Occurrence and Diagnosis of Infections with the Parasite

By JOHN T. LUCKER, B.S., M.A.
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WITHIN the past three years the Bureau of Animal Industry has been requested on eight occasions to identify small larval nematodes found in the feces of hospitalized dogs or of dogs in a kennel under the care of a veterinarian. Usually it was stated or implied that the larvae had been found in fresh feces. Examination of the fecal samples submitted showed that in seven cases the larvae in question were those of Strongyloides. In the remaining case they were identified as those of a member of the superfamily Metastrongyloidea, the group to which the lungworms belong.

Heretofore Strongyloides has been regarded in the United States as extremely rare and of no special significance as a parasite of dogs. Consequently most veterinarians are not familiar with this parasite and its free-living stages.

Therefore, although this paper deals in part with the occurrence of Strongyloides in dogs, the writer's principal objectives are to describe the parasite and its free-living stages briefly and to show how infections with it can be diagnosed. Data on the life cycle of the parasite, a summary of symptoms reported to be associated with infections produced by it, and suggestions for control and treatment are also included.

Occurrence

In 1939 Augustine and Davey[1] reported the occurrence of Strongyloides in a dog from Attleboro, Mass. They stated that apparently only two such infections had been reported previously, one in China by Fülleborn and one in India by Ware. Later, Augustine[2] mentioned another record from a foreign country and stated that two reports of infection in American dogs had been overlooked by Augustine and Davey.[1] Faust's report,[3] which mentioned the use of a canine strain of Strongyloides in experimental studies, and the same author's later statement[4] that in the vicinity of New Orleans the dog is occasionally found to be naturally infected, were cited by Augustine as one of these American records. The report of Whitney,[5] who stated that on the basis of fecal examinations 13 of 1000 dogs from eastern states harbored *S. stercoralis*, was cited as the second of these records, but Augustine was inclined to question this finding. The report of Kreis,[6] who studied a strain of Strongyloides obtained from a naturally infected dog, presumably from New Orleans, was not mentioned by Augustine in this connection, although elsewhere he referred to certain of Kreis' observations. Since Kreis was associated with Faust for a time, it is possible that the canine strain mentioned by Faust[3] was the same as that referred to by Kreis[6] and that Faust's[4] statement as to the incidence of infection in dogs in New Orleans also was based on Kreis' report.

Regardless of the precise number or status of previously published reports of Strongyloides infections in dogs, the seven records enumerated below are in themselves sufficient to suggest that Strongyloides is a more common parasite of dogs in the United States than was previously believed or suspected. The records which follow have come

[1] Augustine, D. L. and D. G. Davey, 1939. Observation of a natural infection with Strongyloides in the dog. *Jnl. Parasit.* 25:2, pp. 117-119.

[2] Augustine, D. L., 1940. Experimental studies on the validity of the species of the genus Strongyloides. *Am. Jnl. Hyg.* 32:1, pp. 24-32.

[3] Faust, E. C., 1933. Experimental studies on human and primate species of Strongyloides. II. The development of Strongyloides in the experimental host. *Am. Jnl. Hyg.* 18:1, pp. 114-132.

[4] Faust, E. C., 1935. Experimental studies on human and primate species of Strongyloides. IV. The pathology of Strongyloides infection. *Arch. Path.* 19:6, pp. 769-806.

[5] Whitney, L. F., 1936. A study of 1000 fecal examination reports. *Vet. Med.* 31:3, pp. 104-105.

[6] Kreis, H. A., 1932. Studies on the genus Strongyloides (nematodes). *Am. Jnl. Hyg.* 16:2, pp. 450-491.

to light as a result of the vigilance of the veterinarians who communicated with the Zoological Division when they observed unfamiliar larvae in dog feces.

Record 1.—Feces from a dog from Westport, Conn., received from Dr. William R. Leggett in September, 1938, contained rhabditiform Strongyloides larvae; by culturing these and a second sample of feces from the same dog, infective larvae were obtained and dogs were infected with them experimentally. Adult worms obtained at necropsy of some of the experimentally infected animals were identified as Strongyloides.

Record 2.—Sediment centrifuged from a mixture of dog feces and water, received from Dr. Maurice Schooley, Kinston, N. C., in January, 1939, contained partially disintegrated rhabditiform larvae as well as adults and infective larvae, tentatively identified as Strongyloides. Doctor Schooley stated that a kennel of 86 young dogs had "been attacked by this form." Whether all individuals in the kennel were infected was not definitely stated.

Record 3.—Feces from a five-month-old puppy from New Rochelle, N. Y., received from Dr. Norman J. Pyle in April, 1940, contained dead rhabditiform larvae, apparently those of Strongyloides; various free-living stages, including infective larvae, in a second sample from the same dog received from Dr. J. J. Werner, were identified definitely as Strongyloides.

Record 4.—Fecal samples from dogs in a kennel at Norbeck, Md., brought to the Zoological Division in the summer of 1939 by Dr. E. E. Ruebush, contained larvae identified as Strongyloides; this identification was made by Dr. Paul D. Harwood, formerly a member of the technical staff of the Zoological Division. Doctor Ruebush stated that about 15 dogs were infected with these parasites.

Record 5.—Feces and scrapings obtained at necropsy from the intestine of a puppy from Brooklyn, N. Y., received from Dr. Charles E. Fletcher in June, 1940, contained mature and immature parasitic females and young rhabditiform larvae of Strongyloides. Doctor Fletcher stated that similar stages had been found in feces evacuated by the puppy before death.

Record 6.—Dog feces from Norfolk, Va., received from Dr. J. G. Feinberg in November, 1940, contained dead rhabditiform larvae tentatively identified as Strongyloides, and one rhabditiform male that was definitely identified as Strongyloides. Doctor Feinberg stated that similar larvae had been found in the feces of dogs in a particular kennel "in which the infection seems to be enzootic." Cultures of dog feces later received from Doctor Feinberg contained living infective Strongyloides larvae.

Record 7.—Feces from a dog received in February, 1941, from Dr. Charles E. Fletcher, contained disintegrated rhabditiform larvae tentatively identified as those of Strongyloides; infective larvae of Strongyloides were found in another culture of the feces of this dog later obtained from Doctor Fletcher. This dog had been associated, presumably in Brooklyn, N. Y., with the infected animal mentioned in record 5.

The Parasite[7]

Systematic Position.—The genus Strongyloides is placed by zoologists in the family Strongyloididae. In order to avoid confusion, it is important, when referring to this genus and family, that the proper spelling of the names be rigidly adhered to, since some of the widely-known bursate nematodes parasitic in domestic animals belong to groups bearing names closely resembling those in question. The family Strongyloididae is so placed in the scheme of classification as to indicate that its members are more closely related to rhabditoid than to strongyloid nematodes.

The Species in Dogs.—The specific identity of the Strongyloides occurring in dogs has not been settled conclusively. Some investigators regard the dog form as identical with *S. stercoralis*, the species found in man; others consider it a strain or variety of *S. stercoralis*; still others, as a distinct species, *S. canis*. The unsettled status of the species is of no practical importance to the veterinarian, except that it will suggest to him the wisdom of taking steps to protect himself from contact with dog feces containing infective Strongyloides larvae.

Description.—Members of the genus Strongyloides are peculiar among the nematodes parasitic in domestic animals in that

[7] To keep the bibliography within appropriate bounds, citations are omitted for literature consulted in connection with the general information given in this and other sections of this article. For practically all statements concerning the anatomy and development of the various stages of the canine Strongyloides and the differential features of these and the other forms commonly encountered, the writer has relied on his own observations. It is not to be understood, however, that no observations on these subjects have been published by other writers. Statements involving the comparative anatomy of rhabditoid forms other than Strongyloides and Rhabditis are mainly based on data given by Chitwood *et al.* See:

Chitwood, B. G. and M. B. Chitwood, 1937. *An Introduction to Nematology*. Sect. I, pt. I, pp. 1-53.

Chitwood, B. G. and M. B. Chitwood, 1938. *Ibid.*, Sect. I, pt. II, pp. 55-123.

Chitwood, B. G., *et al*, 1940. *Ibid*, Sect. I, pt. III; Sect. II, pt. I, pp. 125-240.

ordinarily[8] only female worms are found in the host. The small intestine is the usual habitat. The worms are small and very slender. The species occurring in the dog is only about 2mm long and about 0.03mm wide. The most conspicuous features in the internal anatomy are the relatively long, more or less cylindroid strongyliform esophagus (Fig. 1) occupying the anterior third of the body, the intestine, the ovaries, and the uteri. The vulva is located near the beginning of the posterior third of the body. The anterior ovary recurves a short distance behind the posterior end of the esophagus and the posterior one recurves just in front of the anus (Fig. 1). The specimens examined by the writer were not gravid and the ovaries were not looped. Possibly in mature specimens the ovaries sometimes may be looped near the point of their recurvature and the loops may be twisted and entwined about the intestine. The relatively short tail is conical and rounded at the tip.

The Free-Living Development

Small rhabditiform[9] larvae of the parasite are found ordinarily in the fresh feces of infected dogs because the eggs deposited by the parasitic female hatch in the host's intestine. Strongyloides is unusual among the nematodes parasitic in domestic animals in that a so-called alternation of generations occurs in the life cycle. The rhabditiform larvae in the feces may undergo either of two developmental cycles. In one of the cycles (indirect), a generation of free-living rhabditiform adults intervenes before strongyliform larvae capable of infecting the host develop.

Direct Development.—In feces or fecal cultures kept at a mean temperature of about 25°C., the rhabditiform larvae feed

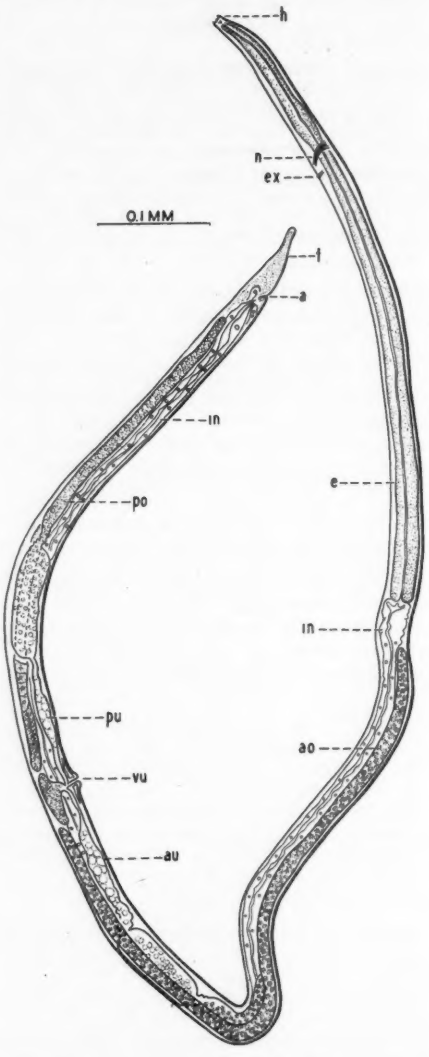


Fig. 1. Strongyloides, parasitic female (non-gravid) from intestine of dog experimentally infected with larvae of a canine strain. (Lateral aspect)

ABBREVIATIONS

a, anus; ao, anterior ovary; au, anterior uterus; e, esophagus; ex, excretory pore; h, head; in, intestine; n, nerve ring; po, posterior ovary; pu, posterior uterus; t, tail; vu, vulva

[8] Parasitic males having a strongyliform esophagus and a structure otherwise comparable to that of the females have never been reported. Parasitic males having a rhabditiform esophagus and a structure otherwise practically identical with that of the free-living males have been reported found within the host's body at necropsy. However, the occasional presence of such males probably means that under unusual circumstances the developmental cycle which normally takes place outside the host's body has occurred *in vivo*.

[9] Although not strictly applicable to Strongyloides larvae and free-living adults, use of this descriptive term is retained in this paper because it is the only one that is both well-known and approximately accurate.

and grow during about the first 36 hours after the feces were passed, but the fundamental structure of the larvae does not change. Shortly after the period mentioned, those of the direct cycle begin to undergo a structural transformation; upon completion of this, about 48 hours after the feces were passed, their rhabditiform characteristics have more or less completely disappeared and they have become strongyliform (filariform) in structure and are infective.

Indirect Development. — Under identical cultural conditions, rhabditiform larvae of the indirect cycle begin to undergo a process of differentiation into sexual individuals in about 36 hours, but their original fundamental structure is retained. In about 48 hours after the feces were passed, these individuals have become free-living rhabditiform males and females. After copulation, the females begin to deposit eggs in the feces in which they live. From these eggs small rhabditiform larvae (second generation) hatch after several hours, and they in turn, about 48 hours after they hatch, transform into strongyliform infective larvae in exactly the same manner as do the progeny of the parasitic female that undergo direct development.

Although either direct or indirect development may occur exclusively in cultures of dog feces, in individual cultures examined by the writer both cycles of development occurred. The number of larvae that developed directly into infective larvae was small; the indirect mode of development predominated in all cultures.

When both cycles of development occur, 48-hour-old cultures contain infective larvae and adult rhabditiform sexual individuals. Since development does not usually proceed at the same rate in all parts of a culture, some larvae still in the process of development to the stages named are usually found along with those already infective or sexually mature. A little later the rhabditiform progeny of the free-living females begin to appear. The females deposit eggs over a period of about three days and then die; the males, too, live only a short time. Since only about 48 hours are required for the larvae of the second generation to reach the infective stage, only infective larvae are recovered as a rule from cultures about seven days old or older.

Description of the Free-Living Stages

Rhabditiform Larvae.—The small larvae found in fresh dog feces are only about 0.25mm long. They are rhabditiform and hence are characterized by having (1) a relatively short muscular esophagus terminating in a valvulated bulb (Fig. 2, B, D, H) and (2) a cylindrical stoma (buccal capsule). Just anterior to the terminal bulb, the esophagus is constricted and narrow; just anterior to the constricted part, it is somewhat bulbous, but the remainder of the anterior portion is more or less cylindroid. A short, distinctly differentiated structure called a vestibule (Fig. 2, B, C), or posterior pharynx, intervenes between the end of the stoma and the beginning of the esophagus proper. The stoma is short and comparatively wide. The intestine, anus, and genital primordium are other prominent anatomical features (Fig. 2, B).

As previously noted, rhabditiform larvae undergoing growth and structural alterations before attaining the infective stage or free-living adult condition occur in older fecal samples or in cultures. As long as the esophagus has a valvulated bulb, a vestibule is readily recognized in all such larvae regardless of their particular phase or cycle of development. A larva destined to become infective, whether hatching from the egg of a parasitic or a free-living female, has a small genital primordium initially and this structure remains small throughout the larva's preparasitic life. A larva destined to become a free-living adult has a comparatively large genital primordium initially and as it grows the primordium increases both in size and in the number of its cells; the male or female reproductive system is formed by division, extension, and differentiation of these cells.

Rhabditiform Adults.—The females (Fig. 3, A) are about 1,000 to 1,500μ (1 to 1.5mm) long. The vulva, located on the ventral surface near the middle of the body, leads to a transverse vagina which is united with

the uteri. In gravid individuals, eggs fill the uteri. The tail is relatively short and tapers to a fine point.

The males (Fig. 3, B) are about 950 to 1,000μ (0.95 to 1.0mm) long. They have two small arcuate copulatory spicules and a smaller leaf-shaped accessory piece or gubernaculum. The spicules usually protrude somewhat through the cloacal opening which marks the beginning of the rather stubby though finely pointed tail. The tail lacks a bursa (caudal alae or cuticular flanges).

In both sexes the esophagus and vestibule are identical in structure with those of the rhabditiform larvae. The stoma is short and wide (Fig. 3, C).

Infective Larvae.—These larvae are very slender, about 530 to 650μ (0.53 to 0.65mm) long by about 17μ (0.017mm) wide. They are strongyliform, that is, the esophagus is elongate, more or less cylindroid, and terminates posteriorly in a non-valvulated, slightly bulbous swelling, only slightly wider than the remainder of the organ. The esophagus, almost one-half as long as the body (Fig. 2, A), leads to the granular intestine. A small genital primordium is located near the middle of the intestine and ventral to it. The tail ends in three minute processes. Since two of these processes are subventral and one dorsal in position, the tip of the tail appears to be notched when the larva is viewed laterally (Fig. 2, A).

Diagnosis of Strongyloides Infection

Post-Mortem Diagnosis.—In animals coming to necropsy Strongyloides infection is diagnosed by recovery of the parasitic females from the small intestine. Because the worms are small and delicate, they may be overlooked unless the intestine is thoroughly examined for them. Cut the intestine into short sections. By means of a large pipette fitted with a large rubber bulb force warm water through the various sections, flushing the contents into a tall glass cylinder or jar. Allow the debris to settle and decant the clear fluid and floating debris. Fill the vessel with water, allow debris to settle, and again decant, repeating the process several times. Examine for worms by placing a small quantity of sediment in a crystallizing dish or large Petri dish containing clear water. Repeat until all sediment has been examined. If a dissecting microscope is available it will aid in the examination. Slit the various sections and place them in a Baermann apparatus to isolate worms deeply embedded in the mucosa.

Diagnosis from Fecal Specimens.—As in the diagnosis of many other helminthic infections, evidence of the presence of the parasites in living animals must be obtained through examination of the feces. As previously noted, small rhabditiform larvae instead of eggs of the parasite ordinarily occur in the fresh feces of infected dogs. The only other larvae of nematodes endoparasitic in dogs that also occur in the fresh feces of this host are those of the metastrongyloid lungworms and their allies, particularly *Filaroides (Oslerus) osleri* and *Angiostrongylus vasorum*. However, metastrongyloid larvae are not rhabditiform and hence can be distinguished readily from young Strongyloides larvae. Therefore, the finding of rhabditiform larvae in fresh dog feces, not contaminated with soil, justifies a tentative diagnosis of Strongyloides infection, particularly if the larvae are of uniform size.

It should be borne in mind, however, that if the feces have become contaminated by contact with soil or vegetable debris the finding of rhabditiform larvae is not conclusive evidence of Strongyloides infection. Moreover, occasionally species of Rhabditis occur on the skin and hair in the perianal region and in skin lesions elsewhere on the body of the dog, and Rhabditis larvae may be present in fecal samples uncontaminated with soil. These larvae, and those of some of the other possible but less likely rhabditoid contaminants, are rhabditiform and hence similar to those of Strongyloides in general appearance and structure. Adults of Rhabditis, and possibly adults of other rhabditoid forms, may be present too in fresh feces or may develop from contaminating larvae after the feces are passed. These adults closely resemble rhabditiform Strongyloides adults. Under unusual circumstances the latter also may occur in fresh feces. It is possible, therefore, that either Rhabditis and Strongyloides adults,

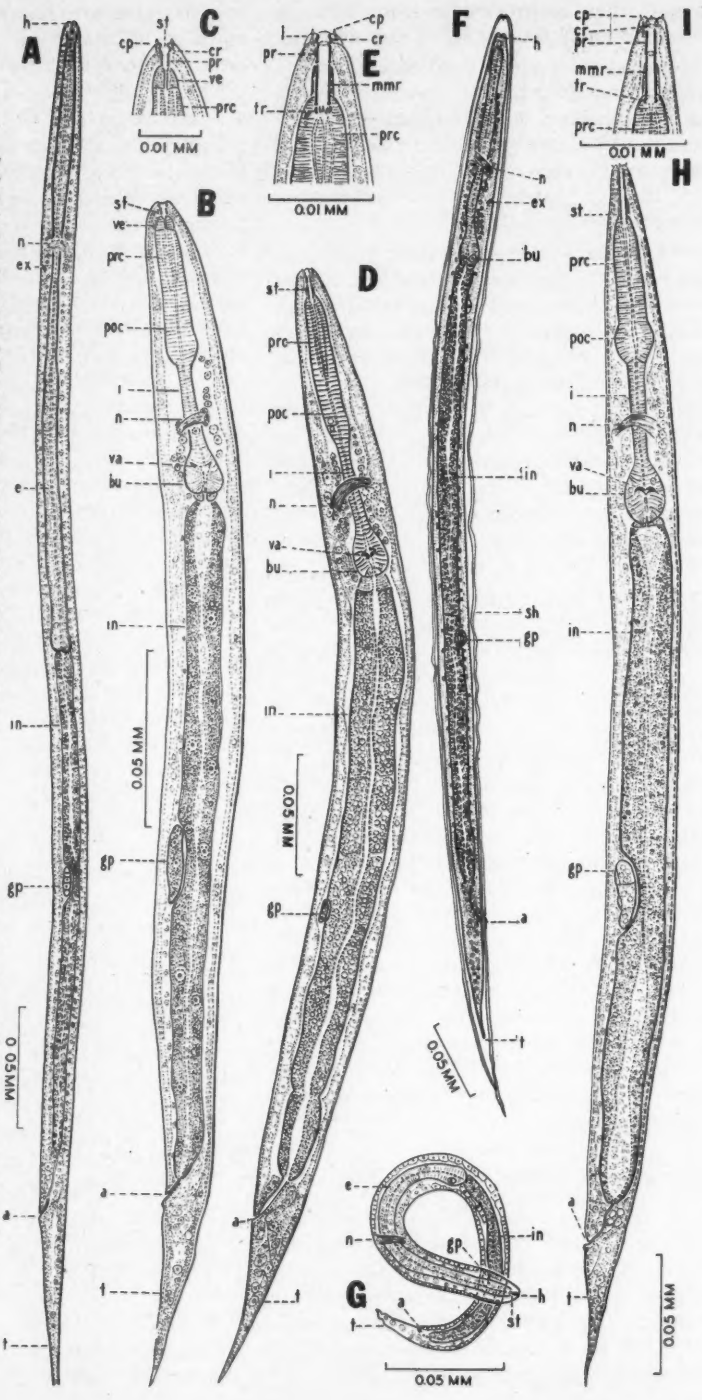


Fig. 2. A-C, Strongyloides, larvae. A—Strongyliform (infective) larva from fecal culture. B — Rhabditiform larva (indirect cycle; first generation) from fresh feces. C—Anterior extremity of rhabditiform larva. D-F, *Ancylostoma caninum* (hookworm), larvae. D — Rhabditiform larva (newly hatched) from 30-hour-old fecal culture. E—Anterior extremity of rhabditiform larva. F—Strongyliform (infective) larva from fecal culture. G, *Filaroides (Oslerus) osleri* (metastrongyloid lungworm), larva of the stage occurring in fresh feces (drawn from a preserved specimen from a female worm from a nodule removed from the trachea of a dog.) H-I, *Rhabditis* sp., larva. H—Young larva from a contaminated fecal sample. I—Anterior extremity. (A-I, lateral aspect)

ABBREVIATIONS

a, anus; bu, terminal bulb of esophagus; cp, cephalic papilla; cr, cheilorhabdion of stoma; e, esophagus; ex, excretory pore; gp, genital primordium; h, head; i, isthmus of esophagus; in, intestine; l, lip; mmr, meso-metarhabdion of stoma; n, nerve ring; poc, postcorpus of esophagus; pr, prorhabdion of stoma; prc, procorpus of esophagus; sh, sheath; st, stoma (mouth cavity or buccal capsule); t, tail; tr, telorhabdion of stoma; va, valve of esophageal bulb; ve, vestibule

or both, may be present in fresh feces as well as in older fecal samples and cultures.

Moreover, if a fresh fecal sample is not available for examination and feces passed more than about 20 to 24 hours previously must be used, newly-hatched rhabditiform hookworm larvae are likely to be present and to be confused with rhabditiform Strongyloides larvae.

It is evident, therefore, that immediate and positive diagnosis of Strongyloides infection on the basis of the findings in fresh feces, or in feces not yet containing infective larvae, requires the differentiation of rhabditiform Strongyloides larvae or adults from the forms with which they might be confused. Since differentiation rests on rather inconspicuous structural features, not only a knowledge of the diagnostic characteristics, but also some familiarity with comparative nematode anatomy and careful observation are essential.

However, identification and differentiation of infective larvae of Strongyloides are comparatively simple, and the diagnostic procedure recommended in this paper is based on this fact. If strongyliform larvae are found on the first examination of cultures in accordance with this procedure (48 hours after the feces were passed), diagnosis is greatly simplified. No strongyliform stage occurs in the development of Rhabditis, the most likely contaminant, and it is impossible for strongyliform (infective) hookworm larvae to be present so soon. If the direct cycle of development does not occur, or if infective larvae are not detected on the first examination, another examination must be made later. But even then it is usually necessary to make but a single differentiation, namely, to distinguish infective Strongyloides from infective hookworm larvae.

Recommended Procedure for Diagnosis

(1) Obtain a fresh sample of feces and examine a part of it. (2) If larvae are found, determine whether they are rhabditiform. (3) If they are, prepare a culture from the remainder of the fecal sample. (4) After about two days, examine half of the culture for infective strongyliform larvae; if none are found, examine the remainder of the culture four or five days later. (5) Identify infective larvae found at either examination.

Examination of Feces and Cultures.—Fecal smears or the salt or sugar solution flotation technics, usually employed for routine fecal examinations, may reveal rhabditiform larvae of Strongyloides in the feces of infected dogs, but small numbers of larvae are not likely to be detected by any of these methods. Moreover, it is difficult to study the structure of the larvae in smears because of the presence of fecal debris. Furthermore, the high specific gravity of salt or sugar solutions is likely to cause the larvae to shrivel. Consequently, for examination of fresh feces the Baermann apparatus, or some improvised device based on the same principle, should be used to isolate the larvae from the fecal particles. The Baermann apparatus is described in detail in textbooks of parasitology. It operates as follows: The feces are placed on a screen suspended in a funnel closed at the bottom by means of a rubber tube provided with a clamp and filled with water warmed to a temperature of about 100°F. The larvae gradually accumulate in the water in the tube just above the clamp and may be withdrawn into a small dish or a test tube with a small amount of the water. When a small drop of water containing several larvae has been transferred to a slide, the slide should be heated slightly to inactivate the larvae, or a few drops of an aqueous solution of iodine should be added to the water on the slide to kill them. If the latter method of killing the larvae is used, only enough iodine to stain them a faint yellow should be added. When a coverslip has been applied, the edges should be sealed with melted paraffin to prevent evaporation. The same steps should be followed in isolating free-living adults or infective larvae from feces or cultures and in preparing them for examination. An oil-immersion objective should be used for microscopic examination of all developmental stages, but a good high-power dry objective may prove satisfactory.

Tentative Diagnosis.—To establish whether the larvae isolated from fresh feces are

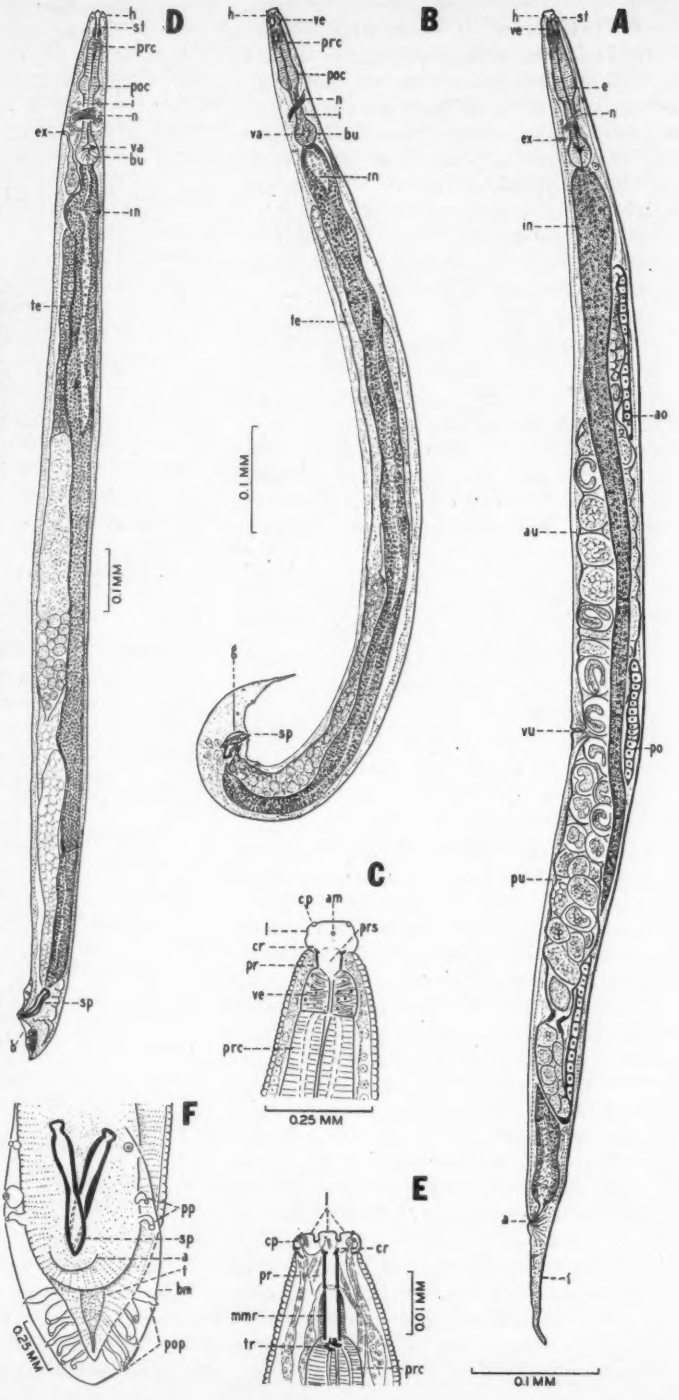


Fig. 3. A-C, Strongyloides rhabditiform free-living adults from fecal culture. A—Female. B—Male. C—Anterior extremity of male. D-F, *Rhabditis* sp., adults from contaminated feces. D—Male. E—Anterior extremity of female. F—Caudal extremity of male. (A-E, lateral aspect; F, ventral aspect)

ABBREVIATIONS

a, anus; am, amphid; ao, anterior ovary; au, anterior uterus; b, bursa; bm, bursal membrane; bu, terminal bulb of esophagus; cp, cephalic papilla; cr, cheilorhabdion of stoma; e, esophagus; ex, excretory pore; g, gubernaculum; h, head; i, isthmus of esophagus; in, intestine; l, lip; mmr, mesometahabdion of stoma; n, nerve ring; po, posterior ovary; poc, postcorpus of esophagus; pop, postanal caudal papillae; pp, preanal caudal papillae; pr, prorhabdion of stoma; prc, procorpus of esophagus; prs, prostom of stoma; pu, posterior uterus; sp, spicules; st, stoma (mouth cavity or buccal capsule); t, tail; te, testis; tr, telorhabdion of stoma; va, valve of esophageal bulb; ve, vestibule; vu, vulva

rhabditiform, it is necessary only to examine the esophagus to see whether it has a three-parted valvulated structure (Fig. 2, B, D, H). The purpose of this examination is to eliminate the possibility that the larvae may be those of a metastrongyloid parasite. So far as is known, the larvae of all metastrongyloid parasites, in all developmental stages, are strongyliform (Fig. 2, A, F, G). Metastrongyloid larvae may be recognized by reference to Figure 2, G; the appearance of the tail is especially characteristic.

Preparation of Cultures.—Thoroughly admix approximately equal amounts of feces and granular animal charcoal, adding enough water during the process to make the mixture moist, but not wet. Place the mixture in the bottom half of a Petri dish and cover with the lid. Under favorable conditions infective larvae will develop in unaltered feces, but development occurs more readily in such cultures.

Identification and Differentiation of Infective Larvae.—Infective Strongyloides larvae (Fig. 2, A) may be distinguished from all other strongyliform larvae encountered in dog feces by the following characteristics: (1) lack of a sheath; (2) a ratio between the length of the esophagus and length of the body of almost 1:2; (3) notched appearance of the tip of the tail; and (4) extreme slenderness.

Strongyliform (infective) hookworm larvae are ensheathed; they do not have a notched tail and are not as slender as infective Strongyloides larvae. In hookworm larvae, the ratio of the length of the esophagus to the length of the body is about 1:3, or more (Fig. 2, F). The metastrongyloid larvae most likely to be encountered are, as already stated, strongyliform, and are not ensheathed, but they are much shorter and comparatively stouter than infective Strongyloides larvae and have a peculiarly shaped tail (Fig. 2, G). Strongyliform Strongyloides larvae which have not yet cast off the cuticle and, therefore, are ensheathed may be encountered if cultures are examined before development has proceeded to completion. However, they may be recognized by other anatomical characteristics previously mentioned. Technically, such larvae are not infective.

Diagnosis by Identification of Rhabditiform Stages

Occasionally it may be necessary to undertake the more difficult task of immediate diagnosis. Some of the morphological features of the rhabditiform stages of Strongyloides have been mentioned as a basis for brief discussion of the differentiation of these stages. The exact nature of the stomatal and other differences useful for their separation from the forms commonly encountered is evident from a comparison of the figures referred to in the following paragraphs. These figures are labeled so as to indicate the presence or absence of comparable or homologous structures.

Rhabditiform Strongyloides larvae can be differentiated from the rhabditiform larvae of hookworms (Fig. 2, D), of all other strongyloid and all trichostrongyloid parasites, and of typical species of Rhabditis (Fig. 2, H) because Strongyloides larvae possess a vestibule (Fig. 2, B, C), whereas those of the other forms mentioned lack one. Also, the stoma of Strongyloides larvae is shallow and wide, whereas that of the other forms mentioned is comparatively deep and narrow and its walls include rhabdions which are rudimentary or absent in Strongyloides (cf. Fig. 2, C. and Fig. 2, E, I).

The larvae of some of the rhabditoid contaminants which might possibly be encountered in dog feces can be distinguished from Strongyloides larvae because in the former (1) the esophagus is not shaped like that of Strongyloides, or (2) it is similarly shaped, but lacks a valve in the posterior bulb, or (3) the bulb is valvulated, but a vestibule is lacking. Stomatal differences also are of value in distinguishing such larvae. The larvae of some other rhabditoid nematodes are so similar to Strongyloides larvae that it is doubtful whether they can be distinguished from them. However, it is very unlikely that they will be encountered in dog feces.

Strongyloides adults can be distinguished from adults of typical species of Rhabditis (Fig. 3, D) by the presence of a vestibule in the former and by means of stomatal and labial differences. The head of Strongy-

loides adults consists of two lateral lips, while in Rhabditis three or six lips are present (cf. Fig. 3, C and Fig. 3, E). Rhabditis males typically have lateral caudal membranes or alae supported by several pairs of rib-like papillae or rays (Fig. 3, F); in certain species, placed by some authors in Rhabditis, the tail extends beyond the bursal membranes as a fine subulate process. Strongyloides males lack a bursa (Fig. 3, B). Many other kinds of possible, but less likely, adult rhabditoid contaminants may be differentiated from Strongyloides because they lack a valvulated bulb, or a vestibule or both. Some others, similar to Strongyloides in these and nearly all other respects, can be differentiated on the basis of stomatal differences. Forms in which the stomatal structures also are practically identical can be differentiated from Strongyloides because none of them possesses two lateral lips.

Modes of Infection and Control

The writer infected a number of dogs percutaneously with Strongyloides; only one dog was given infective larvae orally and a light and transitory infection was established. It is likely that in nature dogs may become infected by either route. When direct development occurs, as it usually does to some extent, infective larvae appear in the feces under favorable conditions within about 48 hours after defecation. Therefore, prompt disposal of feces is of even greater importance for the avoidance of reinfection than it is when dogs harbor hookworms, since the infective larvae of the latter do not develop so rapidly. Infective Strongyloides larvae cannot withstand drying; it is advantageous, therefore, to maintain infected animals in dry surroundings, and to keep uninfected animals from wet surroundings likely to have been contaminated by the feces of an infected mate.

Symptoms Associated with Infections

Among the symptoms and post-mortem findings which veterinarians reported to us as having been observed in dogs infested with Strongyloides were loss of appetite, loss of weight and emaciation, weakness and listlessness, diarrhea or bloody diarrhea, slight cough, lesions on the lungs, and pale mucous membranes. However, in all cases coexistent complicating factors, such as coccidiosis, "intestinal worms," streptococcus infection, and distemper or symptoms of distemper, were also observed. Hence, it is impossible to conclude with certainty that any of the symptoms described actually were referable to Strongyloides infections; but it seems likely that the parasite was at least a contributory factor in the causation of some of them. Faust[9] described pulmonary, intestinal, and cutaneous lesions in dogs experimentally infected with *S. stercoralis* from man. This author[10] also ascribed emaciation, diarrhea, and other symptoms, to Strongyloides infection in human cases. Diarrhea appears to have been mentioned most commonly as accompanying Strongyloides infections in domestic animals generally.

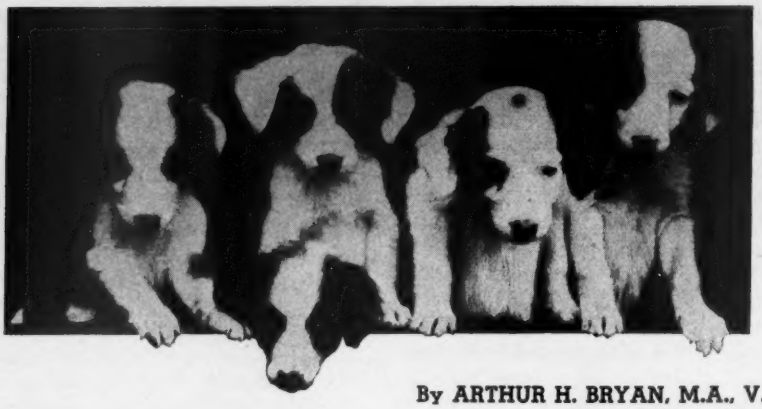
No noteworthy clinical symptoms have been observed by the writer in any of 18 dogs infected with massive doses of larvae of the dog strain. However, the youngest dog used was about five months old and all animals were well fed and were kept under conditions designed to preclude reinfection.

Treatment

Certain of the veterinarians mentioned to us the fact that several drugs ordinarily employed to "worm" dogs appeared to be without effect on Strongyloides. Faust[10] noted that drugs which expel hookworms and ascarids are unsatisfactory for the treatment of Strongyloides infection in man; he stated that of several drugs tested only gentian violet was found satisfactory, and that in the average case a course of treatment consisting of one grain of the dye in enteric-coated tablets administered three times daily for 16 days was usually effective in removing the worms from man. Gentian violet should prove to be an anthelmintic for Strongyloides in dogs, but at present its use would be strictly a matter of experimentation. Its efficacy, safety, and the dosage necessary would have to be determined by repeated trials.

[10] Faust, E. C., 1938. Experimental and clinical strongyloidiasis. *Rev. Gastroent.* 2, pp. 154-158.

Some Therapeutic Indications for the Use of Sulfathiazole in Small Animal Practice



By ARTHUR H. BRYAN, M.A., V. M. D.
Science Department, Baltimore City College
Baltimore, Maryland

SULFATHIAZOLE is the fourth of the sulfonamide group of drugs to pass the critical eye of research and find general therapeutic use in human medicine. It has not yet been licensed for veterinary use. Sulfathiazole is marketed in powder form and in 5-, 7½-, and 15-grain tablets for dispensing.[1]

The author, having previously made clinical observations on sulfanilamide, sulfapyridine,[2] and sulfaguanidine, was able to use his previous work as a basis for evaluating the new drug. Generally, it may be stated that in veterinary practice sulfathiazole appears to be of value in treating the same clinical conditions as sulfapyridine, with possible greater selectivity for staphylococci. It seemed to take a little longer to bring about cures in distemper, distemper pneumonia, and the catarrhal forms of the disease. The new drug, however, appeared less toxic than sulfapyridine; we encountered no cases of emesis or transient anemia following its administration.

The internal dosage is the same as for sulfapyridine: for large dogs, 50 to 60 grains daily (in four to six doses); for toy breeds, 20 grains daily; for cats, 15 grains daily. At this dosage no toxic symptoms were encountered.

Used locally, sulfathiazole is about as effective as sulfapyridine powder when dusted in the peritoneal cavity to prevent post-operative peritonitis.

We have used the powdered drug in all recent cases of otitis media and in ear canker, with very encouraging results. Complete recovery usually resulted after three or four weekly applications of the powder following a thorough cleansing with hydrogen peroxide.

The powdered drug brings about prompt healing of abscesses, following incision and drainage, and of ulcers, after curettement. Implanting sulfathiazole powder or injecting a suspension of the drug in pus areas without drainage is valueless. Surgical incision is a necessary preliminary procedure.

In cases of compound fracture, the drug when freely dusted into the open wound and around the exposed periosteum, tends to prevent tissue or periosteal infections. The infection of compound fractures appears to be a thing of the past, since aseptic healing invariably takes place following the use of either sulfathiazole or sulfapyridine powder.

A 20% suspension of sulfathiazole sprayed

[1] The sulfathiazole used in this experiment was supplied through the courtesy of the Research Department, Ciba Pharmaceutical Products, Inc., Summit, N. J.

[2] Bryan, A. H., 1941. Clinical observations on the use of sulfapyridine in the treatment of canine distemper. *Vet. Med.* 36:7, pp. 365-367; Sulfapyridine in the treatment of feline distemper. *Vet. Med.* 36:8, pp. 434.

on burns of the second degree prevented sepsis.

A few clinical cases may be cited to indi-

Sulfathiazole has proved its usefulness in local septic conditions

cate some of the varied uses of this new drug.

Case No. 1.—French poodle, nine years of age; suppurative vaginitis. A suspension of sulfathiazole was injected into the vagina and thence into the uterus, and the condition cleared up without recurrence in five days.

Case No. 2.—Labrador retriever; pyrexia (temperature 103°F.), pulse 90, catarrhal distemper with rhinitis and pharyngitis in the early stages. This patient recovered in three days after receiving 7½-grain doses of sulfathiazole three times a day for the first two day and five grains three times on the third day.

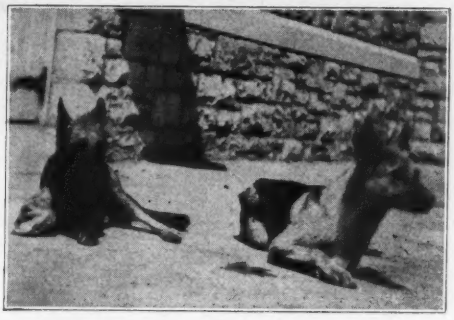
Case No. 3.—Black mongrel; temperature 104°F., catarrhal, bronchial, and skin distemper. This dog was given homologous serum and 23 grains of sulfathiazole daily for three days, and made an uneventful recovery.

Case No. 4.—Cocker spaniel; severe catarrhal distemper, with bronchial complications, temperature 106°F., profuse nasal discharge, dyspnea, purulent conjunctivitis, some emaciation, and dehydration. Five-grain doses of sulfathiazole were administered four times daily before meals. In four days the temperature dropped to normal and the animal commenced to eat.

Case No. 5.—Samoyede bitch, aged six months; catarrhal and gastrointestinal distemper. This dog was unable to retain the sulfathiazole, vomiting it within an hour after administration. In order to administer the drug it was necessary to precede it by a small dose of compound tincture of opium. Recovery was slow in this case, but in ten days the dog was nearly well.

Case No. 6.—Fox terrier; catarrhal distemper, with a history of convulsions, extreme emaciation, and lack of appetite. The dog had been sick two weeks before being brought to the attention of the veterinarian. Previous treatment had consisted of indiscriminate doses of worm medicine and other advertised nostrums. The owner decided to have him destroyed after he had lingered on for a week. However, the sulfathiazole, administered in five-grain doses four times a day, reduced the pyrexia, and the fits were much less frequent.

Case No. 7.—Cocker spaniel, age five years; suppurative otitis media and interna. For a



The sulfa drugs have rapidly become one of the most potent weapons in the veterinarian's armamentarium against canine distemper and other canine infections

period of over a month this dog was given the usual treatments; gentian violet, auralgan, and a soothing prescription made up of:

℞

Calamine lotion 50%
Antipyrine .....15 grains
Glycerin 50%

This preparation gave the dog more relief from pain and pruritus than any prescription previously tried. However, the actual cure resulted from the free dusting of coarse sulfathiazole powder in the ear, and packing the aural cavity to the orifice of the external auditory meatus. The external ear was plugged with cotton for an hour or two to prevent the powder from being shaken out. This dog finally made a complete and uneventful recovery.

Case No. 8.—Pomeranian, age eight months; acute catarrhal distemper, with temperature of 103.6°F. This dog was given three 7½-grain tablets of sulfathiazole at six-hour intervals for three days, at the expiration of which the general symptoms had subsided completely. The local symptoms of conjunctivitis and rhinitis subsided gradually within a week or ten days under topical application of a 10% suspension of sulfathiazole in the nose and eyes.

Case No. 9.—Dachshund, age five months; infection of the upper respiratory tract, with marked pharyngitis, tonsillitis, and rhinitis, and temperature of 101.5°F. The pharynx and

tonsils were swabbed with a 20% suspension of sulfathiazole and the drug was given orally in five-grain doses four times a day, with subsidence of the symptoms within four days.

Sulfathiazole therapy is indicated in feline distemper and similar conditions

Case No. 10.—Pomeranian, age six months; distemper, temperature 104.8°F. The only treatment administered was 20 grains of sulfathiazole, given at four-hour intervals for three days. The drug appeared to check the appetite, for the dog refused all food during the period of its administration. After the sulfathiazole was discontinued he started eating again, with a subsidence of symptoms in five days.

Case No. 11.—Whippet bitch, three years of age; mastitis, vaginitis, and probable pyometritis, following dystocia. The temperature was 103°F. The dog suffered considerable pain and strained intermittently. A 10% suspension of sulfathiazole was injected into the vagina twice daily for two days, and 30 grains of the drug was given *per os* daily at four-hour intervals. The mammary glands were treated with ice-cold applications the first day. The lochial discharges ceased at the end of the second day and the swelling of the mammary glands subsided in the same period. The bitch started eating at the end of the fifth day, and appeared to have made a complete recovery. The milk flow was again utilized by the puppies, which had been bottle-fed in the interim, and they made satisfactory progress.

Case No. 12.—Collie, 18 months of age; chronic distemper with frequent recurrences of symptoms of extreme malaise, with temperature as high as 104°F. and recurrent diarrhea with pronounced dehydration. The dog was treated at different times with all four of the sulfonamide drugs; sulfaguanidine, sulfapyridine, sulfanilamide, and finally sulfathiazole. Encephalitis developed, and the dog died during a violent series of convulsions.

Case No. 13.—Two valuable beagle puppies, 10 months of age; had been suffering from catarrhal and enteric distemper for over two weeks and treated with patent medicines, syrup of buckthorn and pine tar. When presented for treatment both animals were in the last stages of dehydration, with subnormal temperatures. Heroic doses of sulfathiazole, homologous serum, and physiological saline injections failed to save them. These cases emphasize the necessity for early sulfonamide therapy if cures are to be effected.

Case No. 14.—Tabby alley cat, age seven months; feline distemper, temperature 103°F., with marked symptoms of rhinitis, pharyngitis, tonsillitis, and bronchitis. The animal responded to 20 grains of sulfathiazole administered in five-grain doses four times a day before meals for four days. Sulfathiazole powder, blown into both eyes, was successful as a prophylaxis against ulceration of the cornea.

Case No. 15.—Persian cat, age seven months; catarrhal and intestinal distemper. This animal responded to the administration of 20-grain doses of sulfathiazole for three days.

Case No. 16.—Two beagles, from the same litter, were treated for distemper pneumonia. The first was given sulfathiazole in large doses; the second was hospitalized and given the old routine treatment. The animal treated with sulfathiazole recovered in two days; the other grew steadily worse. After 10 days of progressive illness, the second dog was given 30 grains of sulfathiazole for four days, making a complete recovery within a week.

Conclusions

Bearing in mind that prior to the use of the sulfa drugs, canine and feline distemper were to a large extent incurable conditions, with the mortality rate in the former about 50%, and in the latter 80 to 90%, it appears that the results cited in the use of sulfathiazole for distemper and for other infections are distinctly promising. Except in the last case, no effort was made to use controls for this clinical experiment, as was done in the author's observations of the other sulfa drugs. However, a comparison of mortality rates indicates that the use of this new therapeutic agent is certainly justified as a standard procedure in dealing with various canine and feline infections.

Sulfathiazole appeared to be less toxic than the other sulfa drugs, and its action was not quite so drastic as that of sulfapyridine. Sulfapyridine, if it could be tolerated, appeared to check infections more rapidly than sulfathiazole, but the latter caused less nausea and there was no evidence of anemia following its administration.

Leg Fractures in Cows

Two registered Brown Swiss heifers were both struck by an automobile in the same accident.

Fig. 1. Fracture of the distal third of the radius held in place by means of a padded stove pipe

Ordinarily fractures of bones of the leg in large animals such as these, are considered hopeless cases and they are destroyed. However, the heifers were valuable and the owner refused to allow euthanasia, but insisted that they be treated.

An attempt was made to immobilize the fractures. Splints and braces, as illustrated, were made for each case.

The complete fracture of the distal third of the radius, just above the carpus, was held in place by means of a stove pipe with padding over the leg for protection (Fig. 1). To prevent the pipe from slipping downward it was anchored to a leather strap with two rings buckled between hoof and fetlock. The brace was so constructed that the lateral edges overlapped. Hooks were riveted on the piping as shown and baling wire was used for lacing. This heifer lost no weight and when the stove pipe was removed, after three weeks, there was good union with but slight lateral displacement.

In the second heifer there was complete fracture of the distal third of the tibia, just above the hock. This was partially immobilized with a brace made by using a one-half inch water pipe (Fig. 2). Points of contact with the brace were padded and the foot fastened to the brace with a cord. It was found that the animal could lie and arise without assistance by using the brace as a crutch. During the three weeks that the support remained on the heifer she lost considerable weight, but when the brace was removed the union had been established with only two inches of lateral displacement of the lower leg.

Fig. 2. Fracture of the distal third of the tibia partially immobilized with a brace made of water pipe

The owner was pleased with the outcome and so was the veterinarian.

JOSEPH T. ALSTON

Tupelo, Miss.

Tetanus in a Great Dane

October 26th, a client telephoned for a home treatment for lameness in one of her Great Danes. The history was that this bitch and another Dane roamed freely on a large estate, each day following the horseback route of their owners.

Suggested treatment was to look for and clean any cuts, stone bruises or thorns embedded in the pads. The owner's examination revealed no evidence of cuts or bruises. Two days later the foot had become swollen and the animal was unable to put her weight upon it. The owner, a graduate nurse, advised the caretaker to soak the foot in a saturated solution of magnesium sulphate. October 29th they noticed some stiffness in her gait. She also had considerable difficulty in swallowing food. They decided to bring the dog to the hospital on the following day.

October 30th, when the dog was admitted

to the hospital, she presented a typical picture of tetanus. The symptoms were: a general muscular rigidity, stiff gait, tenseness of the cervical muscles, ears pulled erect over the temple and membrana nictitans covering part of the eyeball. Contraction of the masseter muscles made it impossible for the dog to open her mouth, although there was profuse salivation in the presence of food. She showed anxiety for water but was completely unable to swallow or even suck it into her mouth.

The case was diagnosed as tetanus and the owner was told that the prognosis was unfavorable.

Upon examination of the foot, we found a toenail broken at its base and embedded in the surrounding swollen tissue. A slight discharge was seen at this point, which proved to be the focus of infection.

The primary treatment was to remove the broken toenail, enlarge the wound to establish free drainage, and soak the foot in Dakin's solution.

The dog was given an intraspinal injection of 9000 units of tetanus antitoxin, and 15cc of nembutal solution intravenously. She was relaxed for about six hours, but when the nembutal began to wear off, she thrashed around and fell repeatedly in trying to stand up.

This same dosage of antitoxin and nembutal was injected on October 31st, with the addition of 50cc of 50% glucose solution intravenously, and a quart of saline solution containing 5% glucose, subcutaneously.

No improvement being noticed from this treatment, we decided to change the anesthetic. The dog was given 25cc of 25% magnesium sulphate solution intravenously and 25cc of the same solution intraperitoneally, in order to prolong the period of relaxation. The amounts of glucose and saline solutions remained unchanged. The antitoxin was discontinued.

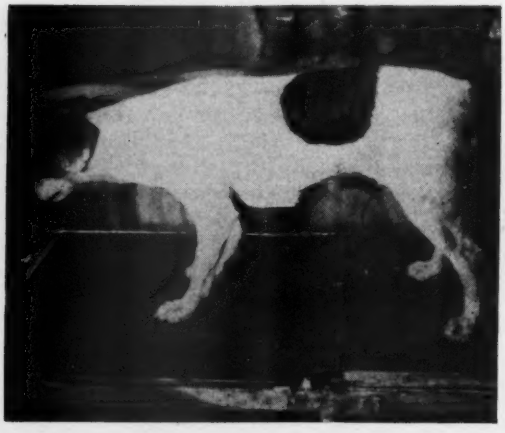
The treatment was repeated daily. No improvement was noticed, however, until November 14th, 21 days after the onset of the attack, when she showed some evidence of muscular relaxation. On this day, she managed to swallow a few mouthfuls of beef broth which was poured into her mouth. Her condition kept improving until November 19th, when she took some solid particles of meat from the broth and swallowed them.

From this date, the magnesium sulphate and glucose injections were discontinued. However, the diet was still supplemented with the saline infusions until November 24th, when the bitch ate ravenously and seemed to be completely recovered.

She was discharged on November 26th, and all subsequent reports show her to be in perfect health and again at normal weight.

K. K. GOEKJIAN

Shaker Heights, Ohio.



This animal, a patient of C. Herman Beckman, St. Louis, Mo., was suffering from an acute attack of tetanus when the picture was taken. Note the general muscular rigidity characteristic of the disease. Treatment in this case consisted of the administration of antitoxin, the application of heat from an infra-red lamp, and sedatives as required. Recovery from tetanus was practically complete in two weeks, but the dog meanwhile developed distemper with complications, resulting in a prolonged convalescence

Autobiography of a Veterinary Practitioner

By E. T. BAKER, Moscow Idaho

II.

Early Memories

NOT that anyone cares particularly about it; but perhaps a little personal history will give the casual reader an insight into the period in which I grew up, and what impressions were absorbed from that experience.

When eight years of age, I was left the sole survivor of my family, as my only sister had died in June of the preceding year; my mother in October; and my father the following March. I then went to live with my maternal grandmother, bachelor uncle and unmarried aunt. For some reason or other, in our Scotch-Irish community there were many old maids and bachelors. Many of them had been brought over from the "Old Country" by their parents when mere children, and they had stayed at home to take care of their parents when the latter became old and infirm. "Social security" was a family responsibility in those days.

With no children to play with, for the nearest were several miles distant, I found my companions among books and older people. Our house had been built in 1833, and in the attic were many magazines and books dating back to .before the Mexican war. History was my favorite, and this enabled me to slide through school much like a star athlete in college. When the board of directors made their official visit, the teacher would show me off as an example of how she could teach history. How I had learned the history was her secret and mine. She didn't expose my ignorance in other subjects and I reciprocated by keeping quiet about where I had learned the history. This taught me the value of being above the average in one thing. I knew very little about algebra or elementary chemistry then or later, and cared less.

Another thing that influenced my early life was the intensely religious atmosphere that pervaded our community. For this reason, I have never learned to dance or to use tobacco, and I was over 18 before I knew one card from another. Whiskey was taken for granted, for every family had a gallon jug of choice rye, and strange as it may seem, there was little drunkenness. I have always thought a well-balanced diet is the best preventive for an alcoholic craving, and if more wives would learn how to cook nourishing meals there might be fewer "chronic drinkers."

On Saturday evening at sundown our Sabbath day really began, and only the most urgent chores were performed until Monday morning. Arising on Sunday at the usual early hour, we started for Sabbath school about nine. After Sabbath school we attended church, to listen to our minister preach for about an hour and a half on infant damnation, foreordination and sanctification. I was compelled to memorize the Westminster catechism, the Proverbs, and the Psalms, and to read the Bible through several times. I was not allowed to read anything secular on the Sabbath and had to content myself with Matthew Henry's *Commentaries*, *Pilgrim's Progress*, Tal-

madges' *Mother, Home and Heaven*, and Foxe's *Book of Martyrs*. I remember being given *The Life of Buffalo Bill* late one Saturday evening, and having it taken away from me until the next Monday. *Jesse James*, which came to hand later, was devoured in one of the most secluded parts of the barn.

Many were the exciting tales of thrilling episodes and daring exploits told by Civil War veterans during the author's boyhood. They were undaunted by the skepticism—or worse—with which their stories were received by other survivors of the War Between the States. Small boys listened pop-eyed to graphic accounts of such stirring actions as the charge of the 5th U. S. Cavalry at Gaines Mill (above)

In those days church services were really an outing for the entire family and community. When the weather was good, the men would congregate down in the grove by the buggy sheds, and hear the news or trade horses. Many a romance budded and thrived as one of the boys shyly talked to some blushing girl out by the graveyard, where such stern inscriptions as "Rebecca J., Beloved Wife of Daniel Marshall" faced the morning sun.

A woman who was sickly and delicate was the envy of all the other farmers' wives. I remember in particular old Grandma Mary Cochran, who was the cynosure of all eyes when she wabbled up the church aisle, supported by her son-in-law. Grandma had started in being a chronic invalid when her tenth child was born in her early thirties. Beginning in a small way she had gradually worked up to the peak of her position, as an invalid, even without an operation. She outlived three husbands, and finally passed away in her sleep at the untimely age of eighty-six.

Several old men crippled around, looking for sympathy and an increase in pension, but as long as Grandma was in sight, they were utterly ignored. One of these men claimed to have had two horses shot under him during the battle of Bull Run, but this incident is more likely to have occurred when he lived over a livery stable. The other man walked with a pitiful limp which he claimed to have received in the battle of

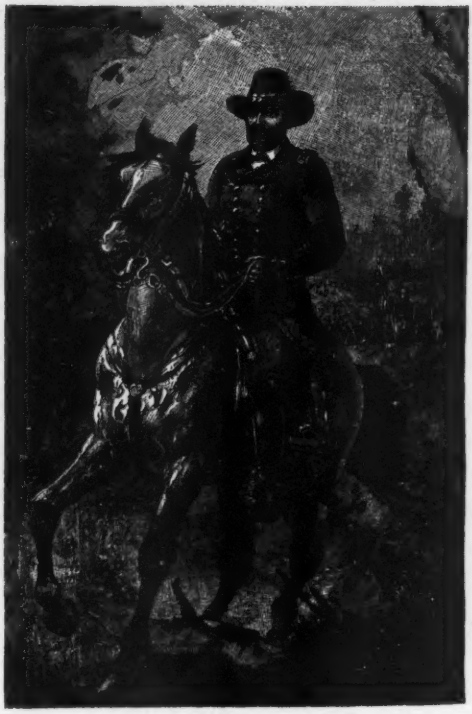
Gettysburg; other veterans said it was due to jumping out of an upstairs window when the house was raided.

I was taught to shun Catholics, Mormons, Democrats and Rebels with the greatest of abhorrence. I read the tales in Foxe's *Book of Martyrs* until my eyes popped out like those of a Boston bull pup in the last stages of exophthalmic goiter. Once an elderly maiden lady with a look of love untold came through our community lecturing on the evils of Mormonism. As I remember her virginal physique and lantern jaw, I tremble to think what might have happened to a Mormon bishop had she found him in her room. He would probably have been like the man who was turned down in the army for flat feet. (He had them in the wrong flat.)

The curious sequelae of these youthful teachings occurred when I stayed with a Catholic family on my first visit from home. To my great surprise, I found them kindly, delightful people, and when I attended their church I was astonished to hear their priest talk very much like our own minister.

As to the Mormons, I have never met a more hospitable or industrious group of people. I have spent several years among them and have the highest regard for their sect.

I had gone down south greatly prejudiced against all Democrats and Rebels, for my Grandmother's brother had lost a leg at the battle of Shiloh. Another relative had spent some months in Libby prison and was severely critical of the menu there. Also, I had read *Uncle Tom's Cabin* with the tears running down the back of my neck as Simon Legree flogged poor old Uncle Tom, and my heart fluttered as it has never fluttered since when Eliza crossed the ice, and little Eva ascended to heaven. However, the Rebels and the Democrats, like the Catholics and Mormons, proved a startling surprise. In Fort Worth, Texas, I stayed with an old southern couple, who were typical of "befo' th' wah" days. The old man had served three years with "Gin-ral Lee, suh," and his wife had been a nurse in Tennessee. From her I learned the other side of the battle of Shiloh. She had a cancer of the face, and



General Grant was the boyhood hero of Northern lads. It was years before the author learned to appreciate the true greatness of Lee, and discovered that Democrats and Rebels were human too; that the abhorrence in which he had held them was a product of the prejudices and narrowmindedness of his community. This and similar readjustments of ideas during the "growing up" process taught him the value of first-hand information in developing tolerance and understanding of others

I used to dress it for her. They both treated me as though I were their only child. When I left to go to college "up No'th" the old lady cried bitterly, and said goodbye to me as tenderly as I imagine my own mother would have done. She passed away the next winter, truly a noble soul.

I merely mention these facts to show how easily one may become narrowminded and intolerant through lack of actual information. Perhaps, if the nations of the world became better acquainted, there would be fewer wars and better understanding all around.

(To be continued)

Abstracts

Endogenous Reservoirs of Mastitis Streptococci

It has been suggested that some cases of mastitis may arise from an endogenous focus within the body rather than from infection through the teat duct from external sources. With this in mind, Francis [5] studied the tonsillar bacterial flora of 100 cattle and examined bacteriologically vaginal swabs from 40 dairy cows.

The predominant organisms found in the tonsils were gram-negative coliform rods and alpha-hemolytic streptococci. *Str. agalactiae* and *Str. bovis* were not identified, but Group II mastitis streptococci were isolated from five animals, Group III streptococci from seven, and Lancefield's Group C streptococci from nine. In addition, *Corynebacterium pyogenes* was found in 18 cattle, staphylococci in four, a hemolytic coccobacillus in six, and a hemolytic diphtheroid in seven. There were also many unidentified strains of streptococci.

From the vaginal swabs, Group II and Group III mastitis streptococci and *C. pyogenes* were each isolated once, and *Str. acidominimus* was identified in 15 cases. *Str. agalactiae* was not found.

While these findings give no support to the view that either the tonsil or the vagina serves as a reservoir for *Str. agalactiae*, it appears that these sites may harbor mastitis streptococci of Groups II and III, and that the tonsil may be an important reservoir for *C. pyogenes*.

[5] Francis, J., 1941. A bacteriological examination of bovine tonsils and vaginas. *Vet. Jnl.* 97, pp. 243-251.

* * * *

Vitamin D in Milk

In milk, as ordinarily produced, the vitamin content varies widely depending upon several factors, among them sunshine and the type of ration.[3] There is increasing evidence of the necessity for adequate vitamin D in the rations of dairy cattle and calves; the development of rickets in calves fed what might be considered "normal" rations has been observed in both practical and experimental operations.

The following nutritional facts are cited as the basis for enhancing the vitamin D of milk by special methods: (a) Vitamin D is needed by humans; (b) this factor is inadequately supplied by generally used food products, including cow's milk as ordinarily produced; (c) sufficient sunshine is not usually available to humans; (d) milk con-

[3] Weckel, K. G., 1941. *Jnl. Dairy Sci.* 24, p. 445. Abstr. from *Vitamin D Digest.*

Pregnancy disease in a ewe

tains calcium and phosphorus which, with vitamin D, form a nutritional triad; (e) milk is widely distributed.

Cobalt Deficiency in Cattle

The authors [6] have shown that a disease of dairy cattle that occurs in the northern counties of Michigan bordering on Lakes Michigan and Huron, known locally as Grand Traverse or lake shore disease, results from a cobalt deficiency in the food. Symptoms consist of progressive debility, anorexia, a marked decrease or cessation of milk flow, depraved appetite, and emaciation. The hemoglobin values of severely emaciated animals varied between 6 and 8gm per 100cc; those of mildly affected cows, from 8 to 10gm. In nearly all cases the hemoglobin values decreased 10 to 20% following administration of cobalt. Hemoglobin regeneration was not so responsive to cobalt supplementation as was desired, but the general response of the cows in appetite, appearance, and increased milk production was highly satisfactory. Analyses of hay samples from affected farms showed that they contained only one-third to one-half as much cobalt as hays from unaffected farms. Biochemical investigations revealed no evidence of ketosis or phosphorus deficiency.

[6] Baltzer, A. C., B. J. Killham, C. W. Duncan, and C. F. Huffman, 1941. A cobalt deficiency disease observed in some Michigan dairy cattle. *Mich. Sta. Quart. Bul.* 24:1, pp. 68-70.

Pregnancy Disease in Ewes

Pregnancy disease (known in South Africa as "domsiekte"—"stupid sickness") has been ascribed to various causes, such as overfatness, lack of exercise, and mineral deficiency. The authors [8] believe that the true cause is starvation.

It has been shown at Onderstepoort that the disease can be produced by suddenly reducing the ration of ewes when they are about four months pregnant. The mechanism of the production of the disease under these conditions is presumably as follows: In the absence of sufficient carbohydrate, the glycogen reserves of the body become seriously depleted, as evinced by hypoglycemia. Consequently the oxidation of fat is incomplete, a fatty infiltration of the liver occurs and ketone bodies appear in the blood.

This condition has been recognized in non-pregnant animals, and even in wethers when starved. That it is usually confined to pregnant animals and is especially likely to appear toward the end of gestation in those carrying twins and/or in older ewes, is explained by the authors on the following bases: (1) Pregnancy, especially from the fourth month, when the most rapid growth of the fetus occurs, increases the carbohydrate drain, this being greater in twin pregnancies. (2) If a heavily pregnant ewe is starved for a short period, she often refuses food when it is again offered, which is not the case in non-pregnant ewes or wethers; thus even a very temporary upset in the feeding of pregnant ewes, at the critical period of gestation, may lead to serious results, whereas it would not affect the non-pregnant stock. (3) Physiological starvation, when plenty of food is available, may follow atony of the rumen. Pressure of the fetus, especially in older ewes where the uterine attachment may be slack, or in ewes with twin lambs, where the pressure would naturally be much greater, may predispose to ruminal atony.

The starvation necessary to produce pregnancy disease may occur in many ways. The authors list: (1) Lack of feed at the critical

[8] Clark, R., and J. W. Groenewald, 1941. Pregnancy disease, or "domsiekte," in ewes. *Jnl. So. Afr. V. M. A.* 12:4, pp. 97-102.

period of gestation; e.g., the available feed may suddenly give out as a result of untimely frost or drought. (2) Inclement weather. Sheep do not feed readily in rainy or inclement weather. Prolonged rain or bad weather at the critical time might, therefore, cause the animals to stop feeding even in the presence of abundant feed; and as pointed out above, even a short interruption in the feeding of heavily pregnant ewes may lead to continued voluntary starvation. (3) Any sudden change in environment. Sheep are sensitive to sudden changes and may refuse to feed in strange surroundings or when they are confronted with an unaccustomed diet. Thus the condition may occur when the pregnant ewes are brought in to be given extra feed. (4) Disturbances in the function of the digestive tract. Any digestive disturbance in late pregnancy may give rise to atony of the rumen, resulting in physiological starvation and consequent pregnancy disease. (5) Ingestion of poisonous plants may cause paresis in the fore-stomachs and intestines of sheep, and set up the chain of events leading to pregnancy disease. Prussic acid in small doses also has a paralyzing effect on the alimentary tract.

As preventive measures, the authors suggest careful flock management, placing emphasis on the necessity of avoiding any sudden change of environment or feed in older pregnant ewes during the last two months of gestation. To guard against a spell of bad weather at the dangerous time, it is suggested that such ewes could previously be made accustomed to feeding under cover, so that should the need arise they can be brought in and fed without any setback. Factors tending to cause atony or impaction of the rumen — too succulent grazing, insufficient roughage, excessively dry grazing, lack of water—should be avoided. Where the presence of prussic acid in the grazing is suspected, licks containing sulphur may be given. Molasses acts as a valuable carbohydrate supplement to the diet and also tends to combat intestinal stasis.

For treatment, the authors recommend the intravenous administration of a 10 to 20% solution of glucose, giving 10gm at a time to a sheep of average size, and repeating if necessary at intervals of a few hours; the intramuscular injection of 3000 I.U. of thiamin daily; and stimulation of the rumen by a ruminal tonic, or by the subcutaneous injection of 1mg of lentin. If the animal can be induced to feed again, a cure is practically certain. If the foregoing measures are unsuccessful in getting the ewe to resume feeding, she should be force-fed. The authors have found a highly proteinaceous food best for this purpose. Meat meal in small quantities can be given easily and has produced good results. Molasses also can be administered safely, *via* stomach tube, even while the animal is in coma.

A complication that has been encountered is death of the fetus without expulsion, in which case the sheep may recover from the symptoms of pregnancy disease, but remain listless and ill, aborting or dying later. Where early abortion takes place, the ewe often recovers spontaneously but may develop metritis subsequently.

Foot-rot in Sheep

Epizootic foot-rot begins with a mild inflammation of the skin in the interdigital space; a breach in the skin-horn junction develops, and during the next five to ten days the infection spreads, causing separation of the horn across the whole sole of the foot.[7] In time the horn may be almost completely separated from the underlying soft tissue. Both digits and usually more than one foot are involved. Animals of all ages are affected and the disease may be much prolonged, but only exceptionally does it involve the deeper structures of the foot.

Epizootic foot-rot should be distinguished from the following conditions: (1) digital suppuration or foot abscess, in which there is usually a considerable amount of pus; the deeper structures of the foot ordinarily being involved. This condition is largely confined to adult animals and to only one

[7] Beveridge, W. I. B., 1941. Foot-rot in sheep; a transmissible disease due to infection with *Fusiformis nodosus* (n. sp.) Studies on its cause, epidemiology and control. *Bul. Coun. Sci. and Indust. Res., Australia*, No. 140. (This abstract is condensed from an annotation of the original publication by John Francis, *Vet. Rec.* 53:50. pp. 734-735.)

digit of the affected foot. (2) Suppurative cellulitis, which commences with patches of dermatitis usually on the back of the

Thoroughly trimming away all necrotic tissue is the first step in the treatment of foot-rot

pastern. These extend rapidly and may eventually reach as high as the corpus or hock. (3) Contagious ecthyma in which vesico-pustular lesions may occur around the coronets as well as the mouth. (4) A condition known in Australia as "scald," which may appear simultaneously in large numbers of sheep, and in which there is an inflamed, scalded appearance of the skin between the digits with some exudation of serous fluid and often slight separation of the horn, particularly around the heels.

There appear to be some unknown but essential predisposing factors. Foot-rot is more prevalent on improved than on natural pastures, and it is well known that moist lush pastures and warm weather predispose to the disease. Sheep 4 to 12 months of age appear to be more resistant than others. Goats are susceptible; but cattle are not. The intact healthy skin is resistant to infection, and although it is believed that maceration due to wetness is the chief predisposing factor, injury due to larvae of the nematode *Strongyloides papillosus* may possibly be such a factor.

It has been shown that foot-rot cannot be set up by standing healthy sheep in "clean" water or mud, but that sheep can be infected regularly by placing them in a pen which has been vacated by infected sheep. Infectivity is never retained in the soil for more than 14 days, and usually much less.

Examination of the bacterial flora showed that lesions of foot-rot always contain a gross mixture of bacteria, chiefly cocci and corynebacteria, near the surface of the lesion. *Fusiformis necrophorus* [*Actinomyces necrophorus*] is frequently present and there may be large numbers of a pleuropneumonia-like organism. In the active areas of lesions the most prevalent organisms are *Spirochaeta penortha* and a motile fusiform organism—*Fusiformis nodosus*—is constantly present, but in relatively small numbers. It is a large gram-negative organism with swollen ends and it is a strict anaerobe.

Inoculation experiments have shown that *F. nodosus* is the primary etiological agent, and it is highly probable that *Sp. penortha* is a specific accessory causal agent. The other organisms present bear no specific relation to foot-rot but may facilitate the survival of the anaerobic causal agents, and *F. necrophorus* may sometimes invade the deeper tissues of the foot.

To control an outbreak, or as a preventive measure, all sheep should be passed once a week through a foot bath containing 10% copper sulphate or 2% formalin. The feet of affected animals should be trimmed. The most successful method of treatment is to dip the foot, after trimming, in a 30% solution of copper sulphate, or a 10% solution of formalin. "Carrier sheep," detected by their deformed feet, should be treated also. These and the affected animals should be isolated from the remainder of the flock until they have recovered, when they should be placed on clean pasture; this is not diffi-

cult because pasture is "clean" if 14 days have elapsed since sheep were last on it.

Using these methods, foot-rot has been eradicated from several large flocks, and the eradication of the disease from Australia is believed to be possible. It is concluded that, once clean, a flock will remain free of the disease indefinitely, even on wet pasture, if reintroduction of infection is prevented.

* * * *

Treatment of Rickettsia Infection in Dogs

The symptoms of canine rickettsiasis are given as a sudden onset of fever, the temperature rising to 104°F. or over, great depression, complete loss of appetite, and rapid emaciation. Five cases were treated by the author [9] with intravenous injections of 10cc of physiological saline solution to which 7 to 10 drops of formalin were added, the treatment being repeated in 48 hours, and a third dose given if required. After treatment a fall of temperature with return to health occurred in all the cases in a few days.

* * * *

Heat-Inactivated Virus

Formalinized Rift Valley fever vaccine was prepared by adding 1:400 formalin to virulent mouse blood or 1:30 liver suspension.[10] The mixture was kept at 4°C. for three days and the formalin then neutralized. This vaccine was inactivated and produced a good immunity when tested in mice. The time at which virulent liver suspension became inactive after heating at various temperatures was ascertained. A suspension heated at 56°C. for one hour was used as a vaccine, although it appears that it contained traces of liver virus which were sometimes capable of producing disease. The immunity was not so reliable as that produced by the formalinized vaccine. Virulent liver suspension diluted to such an extent that it just failed to produce disease did not produce immunity. It was therefore concluded that the immunity produced by the vaccines was due to a true inactivation of the bulk of the virus and not to the mere survival of small traces of fully active virus. [This work has raised a number of fundamental questions, but the small number of experiments, and their planning, make it impossible to draw any valid conclusions.]

* * * *

Methods for Fattening Heifers Tested

The present prices which fat heifers bring indicate a change in the market demand. Ten years ago such heifers, weighing about 900 pounds, sold at a much lower price than fat steers of the same quality and finish. Today they have a better market than most other classes of fat cattle.

During 1941, McCampbell and Weber, of the Kansas experiment station, tested the relative merits of two methods for fattening heifer calves for market.

Ten calves, averaging about 425 pounds in weight, were placed in each of two lots. During the winter Lot 1 was fed Atlas sorghum silage, to which was added daily one pound of cottonseed meal and one-tenth pound of finely ground limestone for each animal. Lot 2 received the same ration and about four pounds of shelled corn daily. Both lots were put on pasture May 6th. For a month beginning July 1st the calves of Lot 2 were fed grain also. Then for three months both lots were kept on full feed in a dry lot. The feed included corn, cottonseed meal and alfalfa hay.

Under prevailing feed prices, both lots made a satisfactory profit. The method used with Lot 1, however, yielded a higher profit per head when the experiment extended over a six months period, since more roughage was consumed and there was not the added cost of grain feeding on pasture. On the other hand, the method practiced with Lot 2 (which received grain) permits earlier marketing than does the method used for Lot 1.

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[9] Pasquini, 1939. Observations cliniques sur l'utilisation de l'eau physiologique formolée en injections intraveineuses, dans le traitement de la rickettsiose du chien. *Rec. Med. Vet.* 115, pp. 216-219. Abst. in *Vet. Bul.* 11:8, p. 557.

[10] Nagano, Y., and T. Sonoda, 1940. Vaccination contre la fièvre de la Vallée du Riff avec le virus inactivé par la chaleur. *Rev. Path. Comp.* 40, pp. 16-21. Abst. in *Vet. Bul.* 11:8, p. 523.